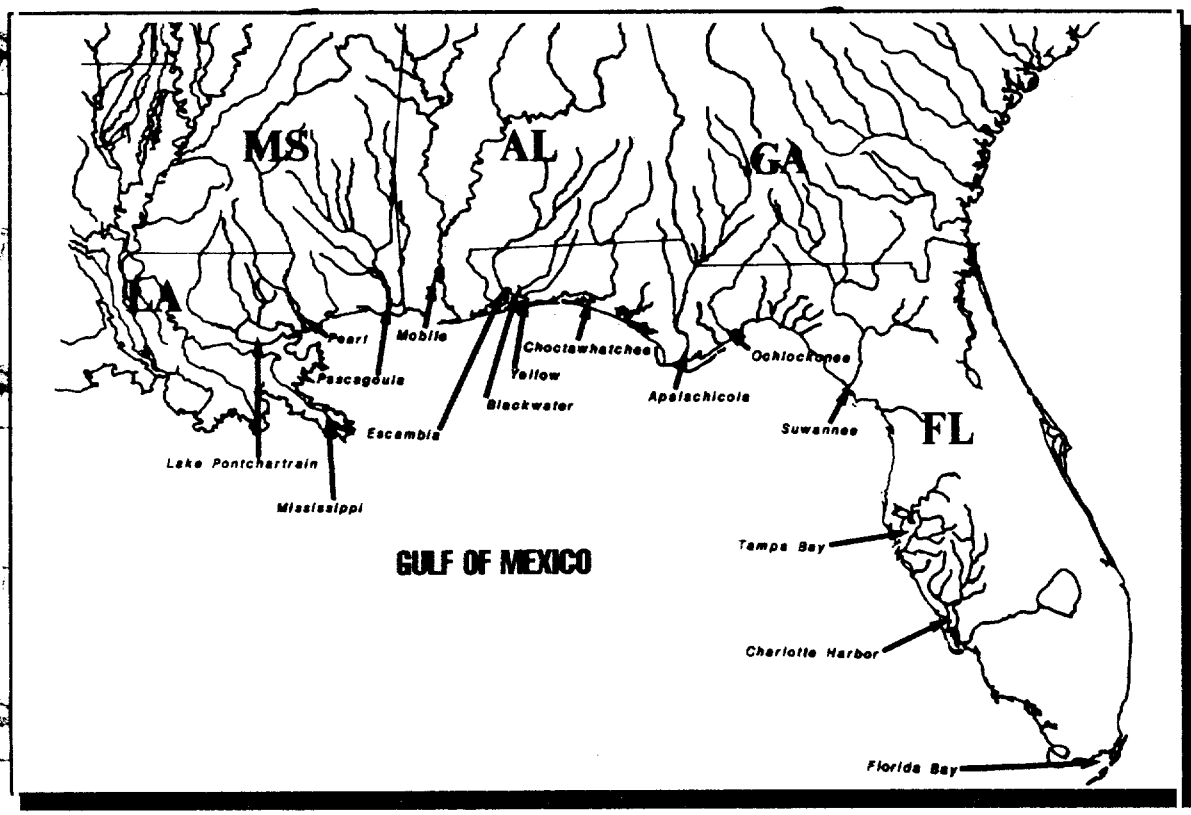
GULF STURGEON
RECOVERY/MANAGEMENT PLAN



GULF STURGEON

(*Acipenser oxyrinchus desotoi*)

RECOVERY/MANAGEMENT PLAN

Prepared by

The Gulf Sturgeon Recovery/Management Task Team

for

Southeast Region
U.S. Fish and Wildlife Service
Atlanta, Georgia

and

Gulf States Marine Fisheries Commission
Ocean Springs, Mississippi

and

National Marine Fisheries Service
Washington, D.C.

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DISCLAIMER PAGE

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, sometimes prepared with the assistance of recovery teams, contractors, state agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. They represent the official position of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service only after they have been signed by the Regional Director of the Fish and Wildlife Service and the Assistant Director for Fisheries of the National Marine Fisheries Service as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

LITERATURE CITATIONS

Literature citations should read as follows:

U.S. Fish and Wildlife Service and Gulf States Marine Fisheries Commission. 1995. Gulf Sturgeon Recovery Plan. Atlanta, Georgia. 170 pp.

Additional copies of this plan may be purchased from:

Fish and Wildlife Reference Service:

5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
Telephone: 301/492-6403
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ACKNOWLEDGEMENTS

The Gulf sturgeon would not have received federal protection without the dedication and persistence of a few individuals who raised our consciousness of the plight of this prehistoric species. Alan Huff completed the first life history of Gulf sturgeon and has since been influential in shaping recovery and restoration efforts. Dr. Archie Carr realized the magnificence of this subspecies, initiating sturgeon studies on the Apalachicola and Suwannee rivers. Each of his sons helped him through the years, the last being Stephen, who has continued the studies after Dr. Carr's death. Stephen's work has resulted in a long-term commitment to the subspecies. The Carrs were funded in their efforts by The Florida Phipps Foundation founded by Mr. John H. (Ben) Phipps. The Foundation continues to support Stephen Carr's work. Mr. Jim Barkuloo, while with the U.S. Fish and Wildlife Service (FWS), was instrumental in persuading the FWS to list the species. Dr. Michael Bentzien completed the tedious procedural work to list the subspecies and has continued to support the team's efforts in preparing the Recovery Plan. The Gulf States of Louisiana, Mississippi, Alabama, and Florida provided protection for the Gulf sturgeon before the subspecies was listed, by prohibiting take of "sturgeon." The states continue to provide protection through implementation of surveys and studies on the Gulf sturgeon so that management decisions can be based on scientific data.

EXECUTIVE SUMMARY

Current Species Status: The current population levels of Gulf sturgeon in rivers other than the Suwannee and Apalachicola are unknown, but are thought to be reduced from historic levels. Historically, the subspecies occurred in most major rivers from the Mississippi River to the Suwannee River, and marine waters of the central and eastern Gulf of Mexico to Florida Bay.

Habitat Requirements and Limiting Factors: The Gulf sturgeon is an anadromous fish which migrates from salt water into large coastal rivers to spawn and spend the warm months. The majority of its life is spent in fresh water. Major population limiting factors are thought to include barriers (dams) to historical spawning habitats, loss of habitat, poor water quality, and overfishing.

Recovery Objectives: The short-term recovery objective is to prevent further reduction of existing wild populations of Gulf sturgeon. The long-term recovery objective is to establish population levels that would allow delisting of the Gulf sturgeon in discrete management units. Gulf sturgeon in discrete management units could be delisted by 2023, if the required criteria are met. Following delisting, a long-term fishery management objective is to establish self-sustaining populations that could withstand directed fishing pressure within discrete management units.

Recovery Criteria: The short-term recovery objective will be considered achieved for a management unit when the catch-per-unit-effort (CPUE) during monitoring is not declining from the baseline level over a 3 to 5-year period. This objective will apply to all management units within the range of the subspecies. Management units will be defined using an ecosystem approach based on river drainages, but may also incorporate genetic affinities among populations in different river drainages. Baselines will be determined by fishery independent CPUE levels.

The long-term recovery objective will be considered achieved for a management unit when the population is demonstrated to be self-sustaining and efforts are underway to restore lost or degraded habitat. A self-sustaining population is one in which the average rate of natural recruitment is at least equal to the average mortality rate in a 12-year period. While this objective will be sought for all management units, it is recognized that it may not be achievable for all management units. The long-term fishery management objective will be considered attained for a given management unit when a sustainable yield can be achieved while maintaining a stable population through natural recruitment. Note that the objective is not necessarily the opening of a management unit to fishing, but rather the development of a population that can sustain a fishery. Opening a population to fishing will be at the discretion of state(s) within whose jurisdiction(s) the management unit occurs. As with the long-term recovery objective, this objective may not be achievable for all management units, but will be sought for all units.

Priority 1 Recovery Tasks:

1. Develop and implement standardized population sampling and monitoring techniques (1.3.1).

2. Develop and implement regulatory framework to eliminate introductions of non-indigenous stock or other sturgeon species (2.5.3).

3. Reduce or eliminate incidental mortality (2.1.2).

4. Restore the benefits of natural riverine habitats (2.4.5).

5. Utilize existing authorities to protect habitat and where inadequate, recommend new laws and regulations (2.3.1).

Costs ($000's) of Priority 1 Tasks:

Year	Action 1	Action 2	Action 3	Action 4*	Action 5
FY 1	59	0	125	26	29
FY 2	73	25	125	48	29
FY 3	114	0	125	48	29
FY 4	108	0	75	31	29
FY 5	108	0	25	0	0

Cost of No. 1 Priority Actions: $1,231,000

* Actual restoration costs undetermined

Total Cost of Recovery: $8,413,000

Date of Recovery: Delisting should be initiated by 2023, for management units where recovery criteria have been met.

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PREFACE

The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) jointly listed the Gulf sturgeon as threatened under the authority of the Endangered Species Act of 1973, as amended (ESA).

The FWS prepared a Report on the Conservation Status of the Gulf of Mexico Sturgeon *Acipenser oxyrhinchus desotoi* in 1988 as a precursor to the listing process. The Gulf States Marine Fisheries Commission (GSMFC) began an initiative in late 1990 to draft a fishery management plan for the Gulf sturgeon. The drafting team (ad hoc subcommittee of the GSMFC Technical Coordinating Committee, Anadromous Fish Subcommittee), on October 1, 1991, in response to the listing, took action to draft a management/recovery plan. This plan meets the requirements of a fisheries management plan as originally begun by the GSMFC, as well as the requirements associated with an Endangered Species Act recovery plan. The plan incorporates the format that has become standard in federal endangered and threatened species recovery plans in recent years. The FWS published a "Framework for the Management and Conservation of Paddlefish and Sturgeon Species in the United States" in March 1993. This document resulted from a workshop sponsored by the FWS that was attended by representatives of other federal agencies, the states, the private aquaculture community, and academia in January 1992. This recovery plan is consistent with the framework document, and in essence, steps down the recommendations and strategies contained therein.

The plan is intended to serve as a guide that delineates and schedules those actions believed necessary to restore the Gulf sturgeon as a viable self-sustaining element of its ecosystem. Some of the tasks described in the plan are ongoing by the FWS, GSMFC, NBS, and the states of Louisiana, Mississippi, Alabama, and Florida. The inclusion of these ongoing tasks represents an awareness of their importance, and offers support for their continuation. Because of this ongoing research on the subspecies, the plan incorporates personal communications and unpublished data.

LIST OF ABBREVIATIONS

ADCNR	Alabama Department of Conservation and Natural Resources
AGS	Alabama Geological Survey
ANSTF	Aquatic Nuisance Species Task Force
CCC	Caribbean Conservation Corporation
CES	Cooperative Extension Service
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COE	U.S. Army Corps of Engineers
CWA	Clean Water Act
CZM	Office of Coastal Zone Management
EIRP	Environmental Impact Research Program
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FDEP	Florida Department of Environmental Protection
FDNR	Florida Department of Natural Resources
FERC	Federal Energy Regulatory Commission
FGFC	Florida Game and Fresh Water Fish Commission
FRTES	Fisheries Resources Trace Elements Survey
FSBC	Florida State Board of Conservation
FWS	United States Fish and Wildlife Service
GCRL	Gulf Coast Research Laboratory
GSMFC	Gulf States Marine Fisheries Commission
GSRMA	Gulf States Resource Management Agencies (TX,LA,MS,AL,FL)
LDWF	Louisiana Department of Wildlife and Fisheries
MDWFP	Mississippi Department of Wildlife, Fisheries, and Parks
MMS	Minerals Management Service
NBS\BSC	National Biological Service, Southeastern Biological Science Center
NCSU	North Carolina Cooperative Research Unit, North Carolina State University
NGO	Nongovernmental organizations
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service (formerly SCS)
OCS	Outer Continental Shelf
SCS	Soil Conservation Service
TED	Turtle Excluder Device
USGS	United States Geological Survey
WES	Waterways Experiment Station
WSRFC	Warm Springs Regional Fisheries Center

LIST OF SYMBOLS

m	meter
mm	millimeter
cm	centimeter
kg	kilogram
km	kilometers
in	inches
ft	feet
mi	mile
lb	pound
hr	hour
°F	degrees Fahrenheit
°C	degrees Centigrade
ft/s	feet per second
m/s	meters per second
m^3/s	cubic meters per second
r	correlation coefficient
SD	standard deviation
TL	total length
FL	fork length
P	probability
hectare	not abbreviated
acre	not abbreviated

I. INTRODUCTION

NOMENCLATURE

The scientific name for Atlantic sturgeon is *Acipenser oxyrinchus* Mitchill. This species consists of two geographically disjunct subspecies: the Gulf sturgeon, *Acipenser oxyrinchus desotoi*, which inhabits the Gulf of Mexico watersheds, and the Atlantic coast subspecies, *Acipenser oxyrinchus oxyrinchus*.

Gilbert (1992) discovered that the species name of the Atlantic sturgeon has been "...misspelled for over one hundred years..." as *oxyrhynchus* rather than *oxyrinchus*. Consequently, based on the rules of zoological nomenclature, *oxyrinchus* is used throughout this plan.

Other colloquial names, in addition to Gulf sturgeon, are: Gulf of Mexico sturgeon, Atlantic sturgeon, common sturgeon and sea sturgeon.

TAXONOMY

Class: Osteichthyes
Order: Acipenseriformes
Family: Acipenseridae
Genus: Acipenser
Species: oxyrinchus
Subspecies: desotoi

Type Specimens

The holotype was collected from the mouth of Singing River (West Pascagoula River) in Mississippi Sound off Gautier, Mississippi and is housed in the U.S. National Museum of Natural History, Washington, DC. The paratype was collected with the holotype and is deposited in the Chicago Natural History Museum (Vladykov 1955).

Current Taxonomic Treatment

The Gulf sturgeon is a member of the family Acipenseridae which inhabits the Atlantic, Gulf, Pacific and certain freshwaters of the United States (Ginsburg 1952). The family includes five members of the genus *Acipenser*, and three members of the genus *Scaphirhynchus*.

Other sturgeon likely to be found in the same waters with Gulf sturgeon include the pallid sturgeon, *Scaphirhynchus albus*, the shovelnose sturgeon, *S. platorynchus*, and Alabama sturgeon *S. suttkusi* (Rafinesque 1820; Forbes and Richardson 1908; Williams and Clemmer 1991). *Scaphirhynchus* are freshwater sturgeon that are native to the Mississippi and Mobile River systems. They formerly occurred in the upper Rio Grande River in New Mexico, but have not been recorded since 1874 (Lee et al., 1980). The fish are characterized by a flattened shovel-

shaped snout and are easily distinguished from Gulf sturgeon. *Acipenser oxyrinchus desotoi* is the only anadromous sturgeon occurring in the Gulf of Mexico.

Based on morphometrics, Wooley (1985) concluded that *A. o. desotoi* is a valid subspecies. Bowen and Avise (1990) analyzed the genetic structure of Atlantic and Gulf sturgeon using mitochondrial DNA (mtDNA) restriction fragment length polymorphism analysis, and postulated that relatively recent genetic contact had occurred between the two regions because of several shared mtDNA clones and clonal arrays. However, Ong et al. (manuscript submitted) used direct sequence analysis of the mtDNA control region and found three fixed nucleotide site differences between *A. oxyrinchus* from the Atlantic and Gulf coasts. They concluded that subspecific divisions are warranted for *A. oxyrinchus*, based on fixed genetic differences between the forms, their allopatric distributions, and their morphometric and life history differences. Ong et al. also postulated that their data, and those of Bowen and Avise (1990), indicate that the reproductive isolation between *A. o. desotoi* and *A. o. oxyrinchus* occurred because of climatic fluctuations in the Pleistocene in conjunction with related changes in the size of the Florida peninsula. Further, they noted that even if the two subspecies occasionally mix in ocean waters, the finding of fixed genetic differences between them suggests that homing fidelity is high in *A. oxyrinchus*.

STATUS

The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) designated the Gulf sturgeon to be a threatened subspecies, pursuant to the Endangered Species Act of 1973, as amended (ESA). The listing became official on September 30, 1991. As part of the listing, a special rule was promulgated to allow taking of the subspecies for educational purposes, scientific purposes, the enhancement of propagation or survival of the subspecies, zoological exhibition, and other conservation purposes consistent with the ESA. The special rule will allow conservation and recovery activities for Gulf sturgeon to be accomplished without a federal permit, provided the activities are in compliance with applicable state laws (FWS 1991a).

DESCRIPTION

Gulf sturgeon are anadromous fish with a sub-cylindrical body imbedded with bony plates or scutes. The snout is greatly extended and bladelike with four fleshy barbels in front of the mouth, which is protractile on the lower surface of the head. The upper lobe of the tail is longer than the lower lobe (Figure 1). The subspecies is light brown to dark brown in color and pale underneath (Vladykov 1955; Vladykov and Greeley 1963).

Characteristics common to both subspecies, *A. o. oxyrinchus* and *A. o. desotoi* are: Scutes strongly developed in longitudinal rows; 7 to 13 (average 9.8) dorsal shields; 24 to 35 (average 28.7) lateral shields behind dorsal fin in pairs; elongated fulcrum at base of lower caudal lobe decidedly longer than base of anal fin; head elongate; snout longer than postorbital distance in individuals up to 95.0 cm (38.0 in), but shorter than postorbital distance in older specimens (Vladykov and Greeley 1963).

Figure 1: Gulf sturgeon *Acipenser oxyrinchus desotoi* (from Bigelow et al., 1963)

The most significant morphological characteristic to distinguish *A. o. oxyrinchus* from *A. o. desotoi* is the length of the spleen. Wooley (1985) found *A. o. desotoi* specimens had a mean spleen length versus fork length measurement of 12.3% (range 7.9 to 15.8%, SD 2.5, r = 0.212). *Acipenser o. oxyrinchus* specimens had a mean spleen length versus fork length (FL) measurement of 5.7% (range 2.8 to 8.3%, SD 1.8, r = 0.121) for a statistically significant difference ($P \leq 0.05$) and minimal overlap. He concluded that Gulf sturgeon and Atlantic sturgeon populations are allopatric and are sufficiently discrete to be considered distinct stocks for sturgeon population management.

POPULATION SIZE AND DISTRIBUTION

According to Wooley and Crateau (1985) Gulf sturgeon occurred in most major river systems from the Mississippi River to the Suwannee River, Florida and in marine waters of the Central and Eastern Gulf of Mexico south to Florida Bay (Figure 2). Comparison of historic information and current data indicates that Gulf sturgeon populations are reduced from historic levels (Barkuloo 1988). At present, Gulf sturgeon population estimates are unknown throughout its range; however, estimates have been completed for the Apalachicola and Suwannee rivers.

Extant Occurrences of Gulf Sturgeon

Offshore

A Gulf sturgeon was caught on hook and line in 1965 by Dianne Cox, a FWS employee. The 45.7-cm (18-in) Gulf sturgeon was caught in the Gulf of Mexico, 1.6 to 3.2 km (1 to 2 mi) east of Galveston Island in 6.1 m (20 ft) of water (Reynolds 1993).

The incidental catch of Gulf sturgeon in the industrial bottomfish (petfood) fishery in the north-central Gulf of Mexico from 1959 to 1963 was reported by Roithmayr (1965), based on the documentation of one juvenile specimen. The bottomfish fishery worked an area between Point au Fer, Louisiana and Perdido Bay, Florida from shore to 55 m (180 ft).

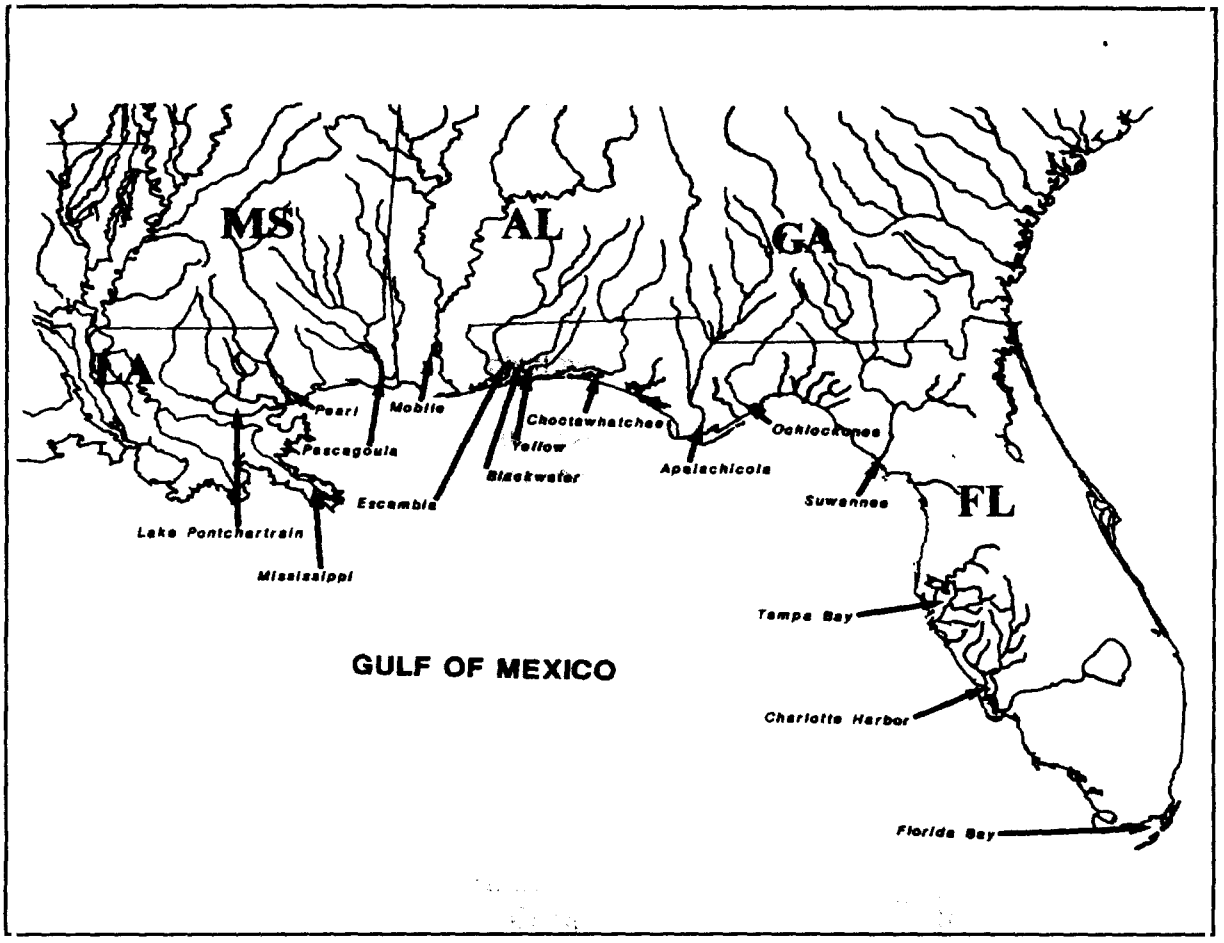

Figure 2: Range of the Gulf Sturgeon

Mermantau River Basin

Mermantau River: The Louisiana Department of Wildlife and Fisheries (1979) reported that an Atlantic sturgeon was caught by a Mr. Hugh Mhire in an otter trawl while shrimping in the Gulf off the mouth of the Mermentau River, Cameron Parish. This specimen was probably a Gulf sturgeon.

Mississippi River Basin

A photograph of a "sea" sturgeon captured at the mouth of the Mississippi River was shown in Fishes and Fishing in Louisiana (1965). Reynolds (1993) reported that a sturgeon measuring 282 cm (111.0 in) and weighing 228.2 kg (503.0 lb) was caught at the mouth of the Mississippi River at Cow Horn Reef in September of 1936.

Mississippi River: A Gulf sturgeon was caught by a commercial fisherman in the auxiliary outflow channel between river km 500.3 (river mi 311.0) of the Mississippi River and river km

16.09 (river mi 10.0) of the Red River on March 28, 1994 (G. Constant, personal communication). The Gulf sturgeon weighed 28.8 kg (63.5 lb) and was 151.2 cm (59.5 in) length and was caught in a 1.2 m (4.0 ft) hoop net.

Lake Pontchartrain Basin

Lake Pontchartrain/Lake Borgne/Rigolets: The Louisiana Department of Wildlife and Fisheries (LDWF) collected twelve Gulf sturgeon weighing 0.22 to 9 kg (0.5 to 19.8 lb) April through June of 1993 (H. Rogillio, personal communication). During a study from January 1990 to March 1993, LDWF collected and tagged 19 Gulf sturgeon weighing 0.25 to 14.5 kg (0.6 to 32.0 lb) from Lake Pontchartrain, Lake Borgne, and the Rigolets (Rogillio 1993). Commercial and sport fishermen incidentally caught 177 Gulf sturgeon measuring up to 220.0 cm (86.6 in) in length and weighing from 1.0 to 68.0 kg (2.2 to 149.9 lb) from Lake Pontchartrain from October 1991 to September 1992 (Rogillio 1993). Reynolds (1993) reported that sturgeon measuring up to 220.0 cm (86.6 in) in length and weighing up to 117.3 kg (258.0 lb) were incidentally caught by shrimp trawlers, netters and recreational anglers from 1989 to 1993 in Lake Pontchartrain. A specimen weighing 53.6 kg (118 lbs) was caught by a hook-and-line fisherman in 1986 (Sentry News 1986). Davis et al. (1970) reported that sturgeon were collected from Lake Ponchartrain during an anadromous fish survey from 1966 to 1969.

Tchefuncte River: Commercial gillnetters incidentally caught 15 Gulf sturgeon weighing from 1.0 to 18.0 kg (2.2 to 39.7 lb) between February and March 1991 in the mouth of the river (H. Rogillio, personal communication). Davis et al. (1970) reported that Gulf sturgeon were collected in trammel nets from the Tchefuncte River during an anadromous fish survey conducted from 1966 to 1969.

Tickfaw River: Davis et al. (1970) reported the collection of sturgeon in trammel nets from the Tickfaw River during an anadromous fish survey from 1966 to 1969.

Tangipahoa River: Davis et al. (1970) reported that sturgeon were collected in trammel nets from the Tangipahoa River during an anadromous fish survey from 1966 to 1969.

Amite River: Davis et al. (1970) reported catch of a sturgeon by a commercial fisherman from the Amite River. Identification of the fish was confirmed by the fisheries biologists with the Louisiana Wild Life (sic) and Fisheries Commission who were conducting an anadromous fish survey.

Pearl River: Esher and Bradshaw (1988) and Bradshaw (personal communication) gill netted a Gulf sturgeon in May 1988 in the lower Pearl River. Sixty-three Gulf sturgeon ranging from juvenile to subadult size were collected from river mile 20 of the Pearl River in 1985 (F. Petzold, personal communication). A 72.7 kg (160.3 lb) female Gulf sturgeon was caught just south of Jackson, Mississippi in 1984 by Miranda and Jackson (1987). The FWS donated a Gulf sturgeon caught by a commercial fisherman in the Pearl River at Monticello to the Mississippi Museum of Natural Science Fish Collection

(MMNS 20206) in 1982 (C. Knight, personal communication; W. McDearman, personal communication). The MDWFP measured and photographed a 119.0 kg (263.0 lb) Gulf sturgeon, 2.2 m (7.25 ft) in length taken by a commercial fisherman below the Ross Barnett Reservoir spillway in 1976 (W. McDearman, personal communication). McDearman and Stewart (personal communication) also note that in the Pearl River between Georgetown and Monticello, Mississippi, there is an area where 2 to 3 Gulf sturgeon are routinely reported by commercial fisherman every 4 to 5 years. In 1971 a Gulf sturgeon from the Pearl River was examined as part of a parasite study (N. Jordan, personal communication). Davis et al. (1970) reported the catch of Gulf sturgeon in hoop nets from the Pearl River at Highway 90 during an anadromous fish survey from 1966 to 1969. The Gulf sturgeon ranged in size from 15.2 cm (6.0 in) to 187.9 cm (74.0 in).

Middle Pearl River: Two Gulf sturgeon were collected in the Middle West Pearl River, St. Tammy Parish, Louisiana, one on March 1, 1995, and the other on March 2, 1995, by the U.S. Army Corps of Engineers, Waterways Experiment Station (WES). The Gulf sturgeon were collected in gill nets and the first sturgeon caught weighed 0.28 kg (0.62 lb) and measured 36.2 cm (14.3 in) in total length. The second Gulf sturgeon weighed 0.28 kg (0.62 lb) and measured 43.5 cm (17.1 in) in total length. Both fish were tagged with Peterson discs and released (M. Chan, personal communication).

Louisiana Department of Wildlife and Fisheries personnel collected 77 Gulf sturgeon from the west Middle Pearl River in 1994 (H. Rogillio, personal communication). The fish ranged in length from 45.7 to 165.1 cm (18 to 65 in). The majority of the fish (84 percent) ranged in length from 74.0 to 114.3 cm (29 to 45 in). The LDWF also collected 14 Gulf sturgeon weighing 1.5 to 14.5 kg (3.3 to 32 lb) in the Middle and west Middle Pearl River from June 1992 through June 1993 (H. Rogillio, personal communication). Two of those specimens were tagged with radio tags. The LDWF also collected 13 Gulf sturgeon weighing 0.27 to 4.3 kg (0.6 to 9.5 lb) in the Middle Pearl River (Drumhole) from April to May 1992 (Rogillio 1993). Commercial fishermen caught one Gulf sturgeon weighing 45.0 kg (99.2 lb) in the Middle Pearl River in February 1991.

Bogue Chitto: Three Gulf sturgeon were also captured by LDWF in the Bogue Chitto River below the Bogue Chitto sill in 1993. The Gulf sturgeon weighed from 2.9 to 4.5 kg (6.5 to 14.5 lb) (H. Rogillio, personal communication).

East Pearl River: Biologists with the FWS gill netted a Gulf sturgeon from the Mikes River, a tributary to the East Pearl River during a fishery survey in the spring of 1992. The fish was 0.7 m (2.3 ft) in length (P. Douglas, personal communication). Davis et al. (1970) reported that one sturgeon was collected in a trammel net from the East Pearl River on November 1, 1968 during an anadromous fish survey conducted from 1966 to 1969.

West Pearl River: Commercial fishermen caught five Gulf sturgeon weighing from 0.1 to 0.3 kg (0.22 to 0.66 lb) in the West Pearl River in October 1990 (H. Rogillio, personal communication).

Mississippi Sound

Bradshaw (personal communication) reported three tag returns from Gulf sturgeon that were incidentally caught by shrimpers working in Mississippi Sound during the fall of 1985. Bradshaw originally collected these Gulf sturgeon from river km 32 (river mi 20) on the Pearl River earlier in 1985. He also noted finding three dead Gulf sturgeon incidentally caught by gillnetters in the western part of the Sound and revived another Gulf sturgeon a gillnetter had caught "on" Horn Island in 1989. Five Gulf sturgeon from Mississippi Sound near Horn Island were examined as part of a parasite study (N. Jordan, personal communication). Of the five sturgeon, one was examined in each of the years 1973, 1976, and 1977, and two in 1982. One Gulf sturgeon [Gulf Coast Research Laboratory (GCRL) #1711] was incidentally caught in a shrimp trawl off the east end of Deer Island in Mississippi Sound in November 1966 in approximately 5.5 m (18 ft) of water. The Gulf sturgeon had a total length (TL) of 75.2 cm (29.6 in). Near this same location J.Y. Christmas (personal communication) reported catching one Gulf sturgeon (GCRL #28) with a TL of 55.2 cm (21.7 in) while sampling with a shrimp trawl in March 1960.

Biloxi Bay

One Gulf sturgeon was incidentally caught in a shrimp trawl in Biloxi Bay off Marsh Point on November 19, 1960 (GCRL #337). The fish was 55.5 cm (22.0 in) TL.

Pascagoula River Basin

Pascagoula Bay: Shepard (personal communication) caught two Gulf sturgeon at the mouth of Bayou LaMotte during the winters of 1991 and 1992 while gillnetting for the J.L. Scott Marine Education Center (GCRL). Reynolds (1993) reported commercial fishermen collecting Gulf sturgeon in and near the mouth of the Pascagoula River in the late 1980's and early 1990's. Shepard (personal communication) reports catching nine Gulf sturgeon from the mouth of the West Pascagoula River while gillnetting from 1983 to 1984. All but one of the sturgeon were caught at the mouth of Bayou LaMotte. The ninth fish was captured near the Sandalwood Canal. One Gulf sturgeon from the mouth of the Pascagoula River was examined in 1970 as part of as part of a parasite study conducted by GCRL (N. Jordan, personal communication).

Pascagoula River: Murphy and Skaines (1994) reported collection of seven Gulf sturgeon in the lower three miles of the Pascagoula River from April to June 1993. Two were radio tagged and released. The fish ranged in length from 46.4 to 111.8 cm (18.3 to 44.0 in) and from 0.8 to 10.4 kg (1.8 to 22.9 lb) in weight. Miranda and Jackson (1987), collected a 78.2 cm (30.8 in) Gulf sturgeon in June 1987 during 30 net-nights from the river. Three Gulf sturgeon were examined from the Pascagoula River as part of a parasite study conducted by GCRL. One was

examined in 1978, the second in 1982 and the third in 1984 (N. Jordan, personal communication).

Chickasawhay River: Miranda and Jackson (1987) reported a catch of a 56.7 kg (125.0 lb) Gulf sturgeon in 1985 from the Chickasawhay River, which is a tributary of the Pascagoula River.

Leaf River: Murphy and Skaines (1994) reported that one of two fish radio-tagged from the lower Pascagoula River in May 1993 was located twice in September of that year. The last documented location of the fish was in the Leaf River three miles downstream from McLain, Mississippi approximately 123.8 km (77.0 mi) from its site of capture.

West Pascagoula River: Two Gulf sturgeon from the West Pascagoula River were examined in 1973 and 1979 as part of a parasite study conducted by GCRL (N. Jordan, personal communication). In December 16, 1964, a Gulf sturgeon (GCRL #4501) was collected by T.D. McIlwain in Big Lake off the West Pascagoula River. The sturgeon weighed 0.24 g (0.52 lb) and was 45.6 cm (18.0 in) TL. The water temperature was 13.9°C (57.0°F) with a salinity of 1.1 ppt.

Mobile River Basin

Mobile Bay: A live Gulf sturgeon was picked up on the shoreline of Bayou LaBatre by a fisherman on March 8, 1993 (F. Parauka, personal communication). The fish was 127 cm (50 in) long and weighed 12.5 kg (27.5 lb). The fish was held for observation at the Dauphin Island Sealab until a FWS biologist measured, weighed, radio-tagged, and collected genetic tissue samples and released it into Mobile Bay a day later. Efforts to locate the sturgeon again were unsuccessful. In July 1972 approximately one hundred Gulf sturgeon were observed at the mouth of the Blakeley River in eastern Mobile Bay feeding in shallow water (Vittor 1972). The sturgeon were approximately .91 m (3 ft) in length.

Mobile River: A Gulf sturgeon about 150 cm (59.1 in) long was sighted in the Mobile River near the head of Mobile Bay on October 3, 1992 by an Alabama Department of Conservation and Natural Resources (ADCNR) Marine Resources Division employee. There is a mounted specimen of a juvenile Gulf sturgeon at the Roussos Restaurant in Mobile, Alabama (J. Roussos, personal communication). The specimen is approximately 45.7 to 50.8 cm (18 to 20 in) TL and was collected in 1985 or 1986. The specimen was caught in a shrimp trawl in the Mobile River, presumably at the north end of Mobile Bay.

Tensaw River: The ADCNR reported that a commercial fisherman incidentally caught a 180 cm (70.9 in) Gulf sturgeon in the mouth of the Tensaw River in September 1991 (W. Tucker, personal communication). M. Mettee (personal communication) reported a 180 cm (70.9 in) Gulf sturgeon was incidentally netted and released in the Tensaw River in April 1986 by a commercial fisherman.

Blakeley River: Commercial gillnetters incidentally caught Gulf sturgeon in the Blakely River during the fall from 1989 to 1991.

Tombigbee River: A specimen caught in June 1987 upstream of Coffeeville on the Tombigbee River was verified by an Alabama Geological Survey (AGS) biologist as *Acipenser* (M. Mettee, personal communication). In 1977 a Gulf sturgeon from the Tombigbee River was examined as part of a parasite study (N. Jordan, personal communication). Incidental catches of Gulf sturgeon still occur annually from the Tombigbee River in the remaining riverine habitat below Coffeeville dam (J. Duffy, personal communication).

Alabama River: Incidental catches of Gulf sturgeon still occur annually from the Alabama River in the remaining riverine habitat below Claiborne dam (J. Duffy, personal communication).

Pensacola Bay Basin

Pensacola Bay: A 56.0 cm (22.0 in) TL Gulf sturgeon was collected in Pensacola Bay on January 20, 1978 (Collection No. 10319, Florida Department of Environmental Protection, FDNR).

Escambia River: Two Gulf sturgeon were collected, tagged and released in the Escambia River about 1.6 km (1.0 mi) downstream of highway 184 bridge in September 1994 by the FWS (F. Parauka, personal communication). The fish weighed 15.5 and 20.7 kg (34.0 and 45.5 lb). Incidental catches of Gulf sturgeon have been reported for the Escambia River (G. Bass, personal communication). Recreational anglers reported that prior to 1980 they would see as many as 10 Gulf sturgeon jumping in the river but now it is rare to see even one fish jump during a fishing trip (Reynolds 1993). Prior to a Florida law prohibiting sturgeon fishing in 1984, a limited commercial fishery existed on that river (National Marine Fisheries Service 1987).

Conecuh River: Annual sightings are reported from the Conecuh River in south central Alabama (J. Duffy, personal communication).

Blackwater River: Three Gulf sturgeon were collected in the Blackwater River during a Florida Game and Fresh Water Fish Commission (FGFC) striped bass netting project in March 1991. The fish weighed from 5.0 to 12.0 kg (11.0 to 26.5 lb) (FGFC, unpublished data).

Yellow River: Eighteen Gulf sturgeon were collected, tagged and released in the Yellow River below Boiling Lake in July 1993 by the FWS (F. Parauka, personal communication). The fish weighed from 5.8 to 63.6 kg (12.7 to 140.0 lb). Gulf sturgeon were collected in the Yellow River during a 1961 to 1962 survey by FGFC (1964). Commercial landings were occasionally reported prior to the 1984 fishing prohibition (J. Barkuloo, personal communication).

Choctawhatchee Bay Basin

Santa Rosa Sound: The U.S. Environmental Protection Agency (EPA) reported a 23 kg (50 lb) Gulf sturgeon washed up on the beach in Santa Rosa Sound near Navarre, Florida in 1988 (F. Parauka, personal communication).

Choctawhatchee Bay: Four Gulf sturgeon were collected by FDEP biologists on April 27, 1993 from Jolly Bay at the eastern end of Choctawhatchee Bay. The sturgeon ranged in length from 41.2 to 81.9 cm (16.22 to 32.2 in).

Choctawhatchee River: Fifty adult and subadult Gulf sturgeon were collected, tagged and released at the mouth of the Choctawhatchee River in April 1994 by the North Carolina Cooperative Research Unit, North Carolina State University (NCSU) and the FWS (Potak et al. 1995). Twenty-five of the fish were equipped with radio tags. The fish weighed from 2.5 to 72.7 kg (5.5 to 160.3 lb) and ranged in length from 73.8 to 192.0 cm (29.1 to 75.6 in). Twenty-seven Gulf sturgeon were captured, tagged, and released in the Choctawhatchee River between Howell Bluff and Rocky Landing in 1988, 1990, and 1991 by the FWS (FWS 1988, 1990, 1991b). The fish weighed from 4.5 to 52.3 kg (9.9 to 115.3 lb). In addition, a 0.13 kg (0.29 lb) specimen caught by an angler downstream from Caryville, Florida in 1991 was tagged and released by the FWS (FWS 1991b). Three Gulf sturgeon weighing from 17.0 to 26.0 kg (37.5 to 57.3 lb) were collected in the upper Choctawhatchee River below its confluence with Pea River at Geneva, Alabama in August 1991 by the FWS (FWS, unpublished data). Annual sightings are reported from the Choctawhatchee River in south central Alabama (J. Duffy, personal communication).

Pea River: Three Gulf sturgeon 91.0 to 213.0 cm (35.8 to 83.9 in) in length were collected by the AGS during March 1992 about 1.0 to 3.0 km (0.62 to 1.86 mi) in the Pea River above its confluence with the Choctawhatchee River (M. Mettee, personal communication). Annual sightings are reported from the Pea River in south central Alabama (J. Duffy, personal communication).

Apalachicola, Chattahoochee, Flint River Basin

Apalachicola Bay: A 34.0 kg (74.8 lb) Gulf sturgeon was caught by a commercial fisherman in a shrimp trawl in Apalachicola Bay in November 1989 (F. Parauka, personal communication). The fish was taken to the Apalachicola National Estuarine Reserve for observation and was later tagged and released at the point of capture by the FWS. A 34.5 kg (76.0 lb) Gulf sturgeon was captured, tagged and released in Apalachicola Bay, south of Hwy 98 bridge in March 1988. Also, in March 1987, a 34.0 kg (74.6 lb) Gulf sturgeon was captured, tagged and released in Apalachicola Bay, north of Hwy 98 bridge (F. Parauka, personal communication). Incidental captures by commercial shrimpers and gill net fishermen in Apalachicola Bay were noted by Wooley and Crateau (1985) and reported by Swift et al. (1977).

Apalachicola River: The FWS Panama City, Florida Field Office has monitored the Apalachicola River Gulf sturgeon population since 1979. Three-hundred and fifty Gulf sturgeon were collected below Jim Woodruff Lock and Dam (JWLD), tagged and recaptured from May through September, 1981 through 1993. The number of fish staying below the dam in the summer was estimated using a modified Schnabel method. Fish smaller than 45.0 cm (17.7 in) TL were excluded because of sampling bias caused by net selectivity. Since 1984, the estimated annual number of fish ranged from 96 to 131 with a mean of 115 (FWS 1990, 1991b, 1992). A 145 cm (57.1 in) FL specimen was captured by FDEP (FSBC 640008) on October 28, 1970 in the river. The FGFC (1964) collected Gulf sturgeon during their anadromous fish survey conducted from 1954 to 1964.

A report of the U.S. Commission on Fish and Fisheries (1902) indicated the Apalachicola River provided the largest and most economically important commercial sturgeon fishery in Florida in 1901. Archie Carr (personal communication) noted that 32 families commercially fished for Gulf sturgeon in the mid-1940's. A commercial fishery continued until the late 1970's with only a few families. Sport fishing for Gulf sturgeon in the spring, and to a lesser extent in the fall, in some of the deeper holes in the Apalachicola River below the JWLD produced fish up to 73 kg (160.9 lb) and 2.3 m (7.5 ft) long (Tallahassee Democrat 1958, 1963, 1969).

Brothers River: Archie Carr (1978 and personal communication) began studying Gulf sturgeon in the Apalachicola River in 1975 and caught only eight sturgeon in 23 days of set-netting in Brothers Creek.

Flint River: Swift et al. (1977) noted a report of a 209 kg (460.8 lb) specimen from the Flint River near Albany, Georgia before 1950, prior to the completion of JWLD in 1957.

Ochlockonee River Basin

Ochlockonee River: Four Gulf sturgeon weighing from 2.0 to 4.0 kg (4.4 to 8.8 lb) were collected in the lower Ochlockonee River at the mouth of Womack Creek in June 1991 (FWS/Panama City and National Biological Survey/Southeastern Biological Service Center-Gainesville (NBS/SBSC-G), unpublished data). Gulf sturgeon were commercially fished in the vicinity of Hitchcock Lake in Wakulla County (Swift et al., 1977; Florida Outdoors 1959). The fish were shipped to the town of Apalachicola for processing and sale to the New York City area. Commercial landings comparable to the Apalachicola River fishery were noted in 1901 (U.S. Commission on Fish and Fisheries 1902). However, most commercial fishing for Gulf sturgeon in the river ended in the early 1970's (F. Parauka, personal communication).

Suwannee River Basin

Suwannee River: The Suwannee River appears to support the most viable Gulf sturgeon population among the coastal rivers of the Gulf of Mexico (Huff 1975). The Caribbean Conservation Corporation (CCC) has captured, marked, and released 1,670 spring migrating Gulf sturgeon at the river mouth since 1986. Based on the recapture of marked fish, the annual

estimated population size ranged between 2,250 to 3,300 for Gulf sturgeon averaging about 18 kg (39.7 lb) (Carr and Rago, unpublished data). An ongoing complementary study by the NBS/BSC-G (unpublished data) has captured, marked, and released about 1,500 subadults, most of which were less than 15 kg (33.1 lb), throughout the river from March 1988 through March 1992. This river supported a limited commercial Gulf sturgeon fishery from 1899 (U.S. Commission on Fish and Fisheries 1902) until 1984 when the State of Florida prohibited harvest and possession.

Tampa Bay Basin

Tampa Bay: A commercial netter incidentally caught and released a Gulf sturgeon 56.4 cm (1.8 ft) in length, one mile west of Redington Beach near St. Petersburg in December 1992 (Reynolds 1993). Before this time, the most recent Gulf sturgeon catch reported from Tampa Bay was a 144 cm (56.7 in) FL female weighing 25.8 kg (56.9 lb), collected on December 11, 1987 near Pinellas Point (FDEP fish collection records, no collection number). Tampa Bay was the location of the first recorded significant sturgeon fishery on the Gulf of Mexico coast, lasting only three years (U.S. Commission on Fish and Fisheries 1902). The fishery began in 1886-1887 with a catch of 1,500 fish yielding 2,268 kg (5,000 lb) of roe. Two thousand fish and 2,858 kg (6,300 lb) of roe were marketed in 1887-1888. The fishery ended after the 1888-1889 season when only seven sturgeon were caught. Sturgeon catches have been reported sporadically since 1890.

Charlotte Harbor Basin

Charlotte Harbor: A 3.0 kg (6.6 lb) Gulf sturgeon was captured by a commercial mackerel net fisherman near the mouth of Charlotte Harbor on January 29, 1992 (R. Ruiz-Carus, personal communication). The sturgeon was caught on a sand bar near Boca Grande Pass, 2.4 to 3.0 m (7.9 to 9.8 ft) in depth. While specific information was given for this fish, the fishermen related that two or three sturgeon of the same size were released alive from the same net set near Boca Grande Pass. Two other specimens have been reported from Charlotte Harbor (University of Florida/Florida State Museum (UF/FSM) 35332; FSBC 18077), one of which is a 24.3 kg (53.6 lb) specimen now mounted at the Florida Marine Research Institute, FDEP, St. Petersburg, Florida.

BIOLOGICAL CHARACTERISTICS

Habitat

Gulf sturgeon are classified as anadromous, with immature and mature fish participating in freshwater migrations (Huff 1975; Carr 1983; Wooley and Crateau 1985; S. Carr, unpublished data; J. Clugston, unpublished data). Anecdotal information, gillnetting, and biotelemetry have shown that subadults and adults spend eight to nine months each year in rivers and three to four of the coolest months in estuaries or Gulf waters. It appears that Gulf sturgeon less than two years old remain in riverine habitats and estuarine areas throughout the year. Many Gulf

sturgeon in the Suwannee River spend summer months near the mouths of springs and cool-water rivers (Foster 1993; S. Carr, unpublished data). The substrate of much of the Suwannee River is sand and limerock, especially in those areas near springs and spring runs.

Wooley and Crateau (1985) reported that Gulf sturgeon in the Apalachicola River utilized the area immediately downstream from JWLD from May through September. The area occupied consisted of the tailrace and spillway basin of JWLD and a large scour hole below the lock. During high flow periods in the late spring when water was passing through open water control gates at JWLD, Gulf sturgeon would congregate in the turbulent flow, often suspended just below the water surface. During the summer, Gulf sturgeon concentrated in the large scour hole below the lock and in the area of the dam spillway basin. This area represented the deepest available water within 25 km (15.5 mi) down-river of the JWLD. Mean total distance moved by Gulf sturgeon during this time was only 0.4 km (0.25 mi). In all cases Gulf sturgeon did not move more than 0.8 km (0.5 mi) from May through September. The area consisted of sand and gravel substrate, water depths ranged from 6.0 to 12.0 m (19.7 to 39.4 ft) with a mean depth of 8.4 m (27.6 ft) and velocities ranged from 60.0 to 90.0 cm/s (2.0 to 3.0 ft/s) with a mean velocity of 64.1 cm/s (2.1 ft/s). Because of the scarcity of historical biological data pertaining to the Gulf sturgeon in the Apalachicola River it is impossible to ascertain whether the area observed as a summer congregation area represents specific historic habitat. It may be the best alternative habitat type available to Gulf sturgeon whose migration upstream was blocked by the construction of JWLD in 1957.

The U.S. Army Corps of Engineers (COE) conducted surveys in this area in November 1991 and October 1992, to characterize flows associated with a strong cross current at the lock approach. In November 1991, velocities were measured at a depth 0.06 and 0.24 m (0.2 and 0.8 ft) of the water column, with velocities ranging from 0.19 to 0.67 m/s (0.61 to 2.19 ft/s) during normal powerhouse generation (two turbines on line with trash gate open). The follow-up survey in October 1992 included an additional measurement within the large scour hole below the lock at a depth within 0.6 m (2 ft) of the bottom. Velocities ranged from 0.08 to 0.92 m/s (0.25 to 3.01 ft/s) for normal powerhouse generation (with or without the trash gate open; with velocities at the bottom of the scour hole ranging from 0.11 to 0.37 m/s (0.36 to 1.2 ft/s) (COE 1993; COE 1994).

The Brothers River, a tributary entering the lower Apalachicola River at river km 19.3 (river mi 12.0) appears to be a staging area for Gulf sturgeon leaving the river (Odenkirk 1989). This was a favorite location for commercial Gulf sturgeon netting in past years (J. Fichera, personal communication). The Brothers River is a sluggish river with deep holes, swampy banks, and a sand and rock bottom. Wooley and Crateau (1985) characterized the habitat as having a mean depth of 11.0 m (36.1 ft), water depths ranged from 8.0 to 18.0 m (26.2 to 59.0 ft) and velocities ranged from 0.58 to 0.75 m/s (1.9 to 2.46 ft/s) with a mean velocity of .60 m/s (1.97 ft/s).

Swift et al. (1977) reported that local fishermen believed that Gulf sturgeon spawning occurred in June in the deeper holes and "lakes" along the rivers. Swift also reported that Gulf sturgeon

were caught by sport fisherman from deep holes in the Apalachicola River below Jim Woodruff Dam during the spring and fall in the late 1950's to the late 1960's.

The WES reported the river conditions during collection of two Gulf sturgeon from the west Middle Pearl River on March 1, 1995. The conditions for at the surface and in 7.62 m (25 ft) of water were: temperature of 15.3°C (59.6°F) and 15.3°C (59.5°F); conductivity of 68 μmho's/cm; dissolved oxygen of 9.09 and 8.80 mg/l; pH of 6.64 and 6.57; and turbidity at the surface of 32 NTU (M. Chan, personal communication).

Bradshaw (personal communication) noted that 62 of 63 of the Gulf sturgeon collected from the East Pearl River at river km 32.2 (river mi 20) in 1985 were from one location, a deep, 12.2 m (40 ft) hole. He also reported that another Gulf sturgeon was captured at the same location in 1988.

Swift et al. (1977) noted that young Gulf sturgeon were reportedly captured in shrimp trawls in Apalachicola Bay. Muddy, soft bottom substrates, the dominant habitat of the Bay, comprise about 78% of the open water zone (Livingston 1984). Wooley and Crateau (1985) reported one Gulf sturgeon was captured 3.2 km (2.0 mi) from the mouth of Apalachicola River in the Bay in approximately 2 m (6.6 ft) depth over a mud substrate. Several Gulf sturgeon were collected from Gulf waters adjacent to Apalachicola Bay (Wooley and Crateau 1985). One Gulf sturgeon was caught 1.2 km (.75 mi) south of Cape St. George in 6 m (19.7 ft) of water and another Gulf sturgeon was captured 1.6 km (1.0 mi) south of Cape San Blas in 15 m (49.2 ft) of water. Limited stomach analyses from Suwannee and Apalachicola River Gulf sturgeon indicate that mud and sand bottoms and seagrass communities are probably important marine habitats for Gulf sturgeon (Mason and Clugston 1993).

Migration and Movement

The movements of Gulf sturgeon in the Apalachicola, Suwannee, Pearl, and Choctawhatchee rivers have been and are being monitored by ultrasonic and radio telemetry and by conventional fish sampling gear (Foster 1993; Carr 1983; Wooley and Crateau 1985; Odenkirk 1989; Rogillio 1993; Clugston et al., in press; Potak et al. 1995; S. Carr, unpublished data; Odenkirk et al., unpublished manuscript; F. Parauka, personal communication; H. Rogillio, personal communication). In general, subadult and adult Gulf sturgeon began to migrate into rivers from the Gulf of Mexico as river temperatures increased to about 16 to 23°C (60.8 to 75.0°F). They continued to immigrate through early May, but most arrive when temperatures reach 21°C. Gulf sturgeon have been collected as far upstream as river km 221 (river mi 137.3) in the Suwannee River. In the Suwannee River, most radio-tracked Gulf sturgeon appeared to settle into four 3.0 to 15.0 km (1.9 to 9.3 mi) long reaches of the river during the summer (Foster 1993). Upstream migration in the Apalachicola River is blocked at river km 171 (river mi 106.3) by the JWLD. Nearly all radio-tracked Gulf sturgeon remained in the dam tailrace during the summer (Wooley and Crateau 1985; Odenkirk 1989).

Wooley and Crateau (1985) reported that of 99 Gulf sturgeon tagged below JWLD, Apalachicola River, 6 were incidentally captured by shrimp trawlers during the fall season in Apalachicola Bay and the adjacent Gulf of Mexico. Bradshaw (personal communication) notes three Gulf sturgeon he collected and tagged in 1985 from the East Pearl River at river km 32.2 (river mi 20) that were incidentally caught by shrimpers in Mississippi Sound in the fall of that year. One Gulf sturgeon, a 53.0 cm (20.9 in) FL individual, was caught near the west tip of Cat Island, a distance of 64.6 km (40 mi) from the release point on the river.

Subadult and adult Gulf sturgeon in the Suwannee and Apalachicola Rivers generally began downstream migration in late September and October. Wooley and Crateau (1985) found that the Gulf sturgeon at the JWLD began their downstream migration in late fall when the temperature dropped to 23°C (73.4°F). Most return to the estuary or the Gulf of Mexico by mid-November to early December. In the Suwannee River, young Gulf sturgeon from about 0.3 to 2.5 kg (0.7 to 5.5 lb) remained at the river mouth during the winter and spring and were the only Gulf sturgeon captured during December, January and early February over a three year period from late 1987 to 1991 (Clugston et al. 1995). Based on mark-recapture data, these young fish did not appear to venture far into the Gulf of Mexico. Tagging (J. Clugston, unpublished data) and other life history studies (Huff 1975) found small Gulf sturgeon at river distributaries indicating that they were spawned in the Suwannee River.

Radio telemetry studies on the Choctawhatchee River conducted by NCSU in the summer of 1994, found that 25 tagged Gulf sturgeon did not distribute themselves uniformly throughout the river and did not occupy the deepest or coolest water available (Potak et al. 1995). Most fish were concentrated in relatively shallow straight stretches of the river. Of the 25 fish, 23 remained within two primary summer holding areas in the middle to lower river. They were found outside the main channel, where water velocities were less than the maximum available. Most of the fish were in water depths of 1.5 to 3.0 m (4.9 to 9.9 ft) and substrates were silt or clay.

Tagging and radio telemetry studies conducted by the LDWF during 1993 and 1994 showed subadult and adult Gulf sturgeon frequented or moved between specific areas from May through September. The most southern site is known as the Drum Hole on the west Middle Pearl River to the upper and lower Fridays Ditch on the west Middle Pearl River. Telemetry data showed movement of fish between Fridays Ditch to the West Pearl River at Powerline and Yellow Lake. Movement was also observed from Gulf sturgeon tagged from the Boque Chitto River below the sill at the canal and Lake Pontchartrain at Bayou Lacombe (H. Rogillio, personal communication).

Three sonic-tagged Gulf sturgeon were tracked into saline water and monitored in Apalachicola Bay for one to four hours in late October 1987. In November 1989, a Gulf sturgeon was monitored in Apalachicola Bay for 72 hours and tracked for 30.0 km (18.6 mi) (FWS 1988, 1989). Four Gulf sturgeon were similarly tracked in late October 1991 outside the Suwannee River and remained for about a week in water depths of 3.0 m (9.8 ft) and 5.0 km (3.1 mi) offshore in an area of mud bottom (Carr, unpublished data).

Gulf sturgeon tagging studies in the Apalachicola and Suwannee rivers demonstrate the high probability of recapture in the same river in which the fish were tagged. Between 1986 to 1992, approximately 3,750 Gulf sturgeon were tagged in the Suwannee River, and of nearly 700 recaptures, all but two were recovered in the Suwannee River. Those two recaptures occurred in the Apalachicola River and offshore near Tarpon Springs, Florida. From 1981 to 1993, a total of 350 Gulf sturgeon were tagged in the Apalachicola River. Of those, 160 were recaptured in the Apalachicola River, while six individuals were recaptured in the East Pass of the Suwannee River (S. Carr, unpublished data) and one was recaptured in the Ochlockonee River (F. Parauka, personal communication). Of those six individuals recaptured in the Suwannee River, three were recaptured the following year in the East Pass. Radio-tracking further suggests that individuals return to the same area of the river inhabited the previous summer (Foster 1993; Carr, unpublished data; FWS/Panama City, unpublished data).

Small Gulf sturgeon were noted to move southward along the western Florida coast to Florida Bay during the winters of 1957, 1959, and 1962 (D. Robins in personal communication to Wooley and Crateau 1985). Several sturgeon, estimated at 60 cm (23.6 in) FL, were also collected in fish traps in Government Cut, Miami, Florida during the winters of 1957, 1959, and 1962 (D. Robins, personal communication). Vladykov examined one of the specimens internally and determined it to be *A. o. desotoi*. These occurrences may have been in response to unusually low winter temperatures.

Stocks

Stabile et al. (unpublished manuscript) used RFLP analysis of mitochondrial DNA (mtDNA) of Gulf sturgeon collected from six geographically disjunct drainages along the Gulf of Mexico. The river systems included the Suwannee, Apalachicola, Ochlockonee, Blackwater, and Choctawhatchee rivers in Florida and the Pearl River in Louisiana/Mississippi. Their preliminary data analysis indicates that there are significant differences among Gulf sturgeon stocks. They found the most notable difference existed between the Choctawhatchee River samples and samples from other Gulf of Mexico rivers. In addition, the results indicated a break between the Apalachicola/Suwannee river populations and populations to the west of the Apalachicola River. Further, their data suggest that Gulf sturgeon display region-specific affinities and may exhibit river-specific fidelity.

Stabile et al. (unpublished manuscript) also indicated population-level polymorphisms using direct sequence analysis in sturgeon from the Gulf coast rivers. They found that Gulf sturgeon analyzed from the Pearl River exhibited haplotypes that were different from all other Gulf coast samples. Polymorphisms at other sites indicated possibly useful markers for discriminating sturgeon from the Choctawhatchee and Yellow rivers. No significant differences of mtDNA haplotypes were found among Gulf sturgeon from the eastern Gulf coast. However, these results are considered tentative because of the small sample size.

Food Habits

In the Suwannee River, stomachs of Gulf sturgeon 38 to 188 cm (15.0 to 74.0 in) FL caught in commercial gill nets 10.0 m (32.8 ft), 24.5 cm (9.4 in) stretch fished in the lower river in East Pass contained digested aquatic plant material interspersed with crab hard parts (probably blue crab, *Callinectes sapidus*). The relative abundance of crab parts was greater in stomachs of migrants entering the river in spring and usually absent from those exiting in fall (Huff 1975). Gammaridean amphipods were primarily found in smaller schooled Gulf sturgeon <82.0 cm (32.3 in) caught with trammel nets in shallow water 1.0 to 2.0 m (3.3 to 6.6 ft) in depth over a sand bank at the river's mouth (Alligator Pass). These prey species are associated with sandy substrates. Other food items included isopods (*Cyathura burbanki*), midge larvae, mud shrimp (Callianassidae), one eel (*Moringua* sp.), and unidentifiable animal or vegetable matter. Huff concluded that these small Gulf sturgeon occupied a different habitat than larger Gulf sturgeon harvested in the gill net fishery.

Mason and Clugston (1993) studied the food habits of Gulf sturgeon on the Suwannee River from 1988 to 1990. In the spring, immigrating subadult and adult Gulf sturgeon collected from the river mouth contained gammarid, haustoriid, and other amphipods, polychaete and oligochaete annelids, lancelets, and brachiopods. However, once in fresh water, these Gulf sturgeon did not eat as evidenced by the presence of only a greenish-tinged mucus in their guts during June through October. Stephen Carr (unpublished data) found in the Suwannee River that immigrating, sexually mature Gulf sturgeon were mainly empty of food; however, of food items present, brachiopods and mud shrimp dominated. By contrast, a 13.6 kg (30.0 lb) Gulf sturgeon was captured by bait trawlers on Red Bank Reef three miles from the mouth of the Suwannee River in spring 1986. Its stomach contained six species of lugworm, two species of clam, five species of crustacea, an echinoderm (sand dollar), an unidentifiable marine worm and two dozen lancelets (S. Carr, unpublished data). Mason and Clugston (1993) found that small Gulf sturgeon (0.5 to 4.0 kg) (1.1 to 8.8 lb) collected at the river mouth during the winter and early spring contained amphipod and isopod crustaceans, oligochaetes, polychaetes, and chironomid and ceratopogonid larvae. Although the guts of these young Gulf sturgeon contained small amounts of food as they migrated upstream to about river km 55 (river mi 34), they too contained only a detrital mass and were essentially empty in the freshwater reaches during the summer and fall. It remains unclear why most subadult and adult Gulf sturgeon feed for three to four months in a marine environment and enter fresh water where they do not feed for the following eight or nine months.

Growth

Huff (1975) used cross sections of pectoral fin rays to estimate the age of 631 Gulf sturgeon collected from the Suwannee River. Because back calculation using fin ray sections was not possible, mean fork lengths for fish ages 1 through 17 were calculated (Figure 3). Mean fork length at age 1 was approximately 35.0 cm (13.8 in) and increased to approximately 145.0 cm (57.1 in) at age 17.

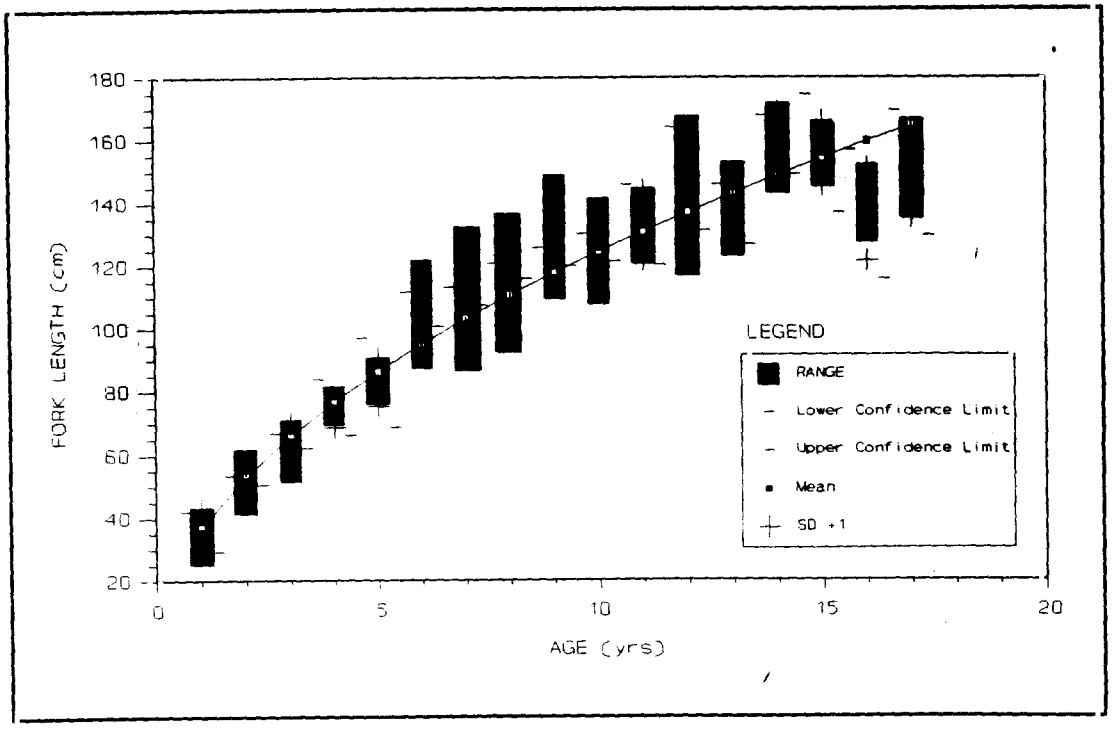

Figure 3: Length-range diagram and regression line,
Gulf sturgeon age groups 1 to 17, from 1972 to 1973 (Huff 1975)

Cross sections of pectoral fin rays were also used to estimate the age of 76 Gulf sturgeon collected from the Apalachicola River, Florida from 1982 to 1990 (Jenkins, unpublished manuscript). Fish ranged from 2 to 28 years old with lengths and weights ranging from 47.0 to 227.0 cm (18.5 to 89.4 in) and 0.2 to 90.7 kg (0.4 to 200.0 lb). Fin rays from four fish exhibited possible spawning belts. Average growth was 24.0 cm (9.4 in) per year for fish two to five years old, and 8.0 cm (3.1 in) per year to the age of eight. Fish marked and later recaptured exhibited similar large growth variations which may be the result of sexual dimorphism. The time of annulus formation was in the late summer and fall, which is a period of weight loss according to mark-recapture studies.

Carr (1983) found that on the average, marked Gulf sturgeon from the Suwannee River gained 30% of body weight in one year. He also noted that little or no growth was seen when recapture occurred during the same season and a little weight was lost by some. Wooley and Crateau (1985) noted that Gulf sturgeon 80.0 to 114.0 cm (31.5 to 44.9 in) FL tagged in early summer in the Apalachicola River below JWLD and subsequently recaptured in the same area in July and September exhibited weight losses of 4% to 15% or 0.5 to 2.3 kg (1.1 to 5.1 lb). Gulf sturgeon from 75.5 to 101.0 cm (29.7 to 39.8 in) FL tagged in September and recaptured the following year between May and September, after spending the winter period feeding in Apalachicola Bay and/or the Gulf of Mexico, showed weight gains of 35% to 137% or 4.3 to 10.2 kg (9.5 to 22.5 lb). These growth rates are considered normal for young Gulf sturgeon.

The recapture of 229 marked fish provided an opportunity to calculate seasonal growth rates of Gulf sturgeon in the Suwannee River (Clugston et al. 1995). It appears that Gulf sturgeon gain weight only during the winter and spring while in marine or estuarine waters and lose weight during the eight to nine month period while in fresh water. In general, Gulf sturgeon weighing between 7.0 kg (15.4 lb) and 27.0 kg (59.5 lb) grew about 11.0 cm (4.3 in) and gained 2.0 to 3.0 kg (4.4 to 6.6 lb) per year. In nearly all cases, however, fish that were marked and recaptured during the same summer lost weight. Those recaptures that spanned the three or four months that most fish were in the Gulf of Mexico increased in weight. Likewise, the young fish collected at the mouth of the river during the winter and spring and recaptured during the same period increased in weight. Lengths and weights were monitored for two Gulf sturgeon hatched and reared for 17 months under laboratory conditions (Mason et al., 1992). In the first year these fish grew to 71.9 cm (28.3 in) and 63.4 cm (25.0 in) in total length and to weights of 1.9 kg (4.2 lb) and 1.4 kg (3.1 lb). After 17 months they grew to 84.6 cm (33.3 in) and 78.7 cm (31.0 in) and to 3.1 kg (6.7 lb) and 2.7 kg (6.0 lb). These two fish received special treatment, and their growth in the laboratory may not represent growth of wild fish. Nevertheless, the data represent the first measured growth of young Gulf sturgeon and provide insight into the species' growth potential.

Reproduction

Timing, location and habitat requirements for Gulf sturgeon spawning are not well documented. Most subadult and adult Gulf sturgeon ascend coastal rivers from the Gulf of Mexico from mid-February through April when some adults are sexually mature and in ripe condition. Studies conducted on the Apalachicola River resulted in the only known collection of wild Gulf sturgeon larvae. Two larvae were collected at river km 168 (river mi 104.2); one on May 11, 1977 (Wooley et al., 1982) and one on May 1, 1987 (Foster et al., 1988). At the time of the 1977 collection, the surface water temperature was 23.9°C (75.0°F), water depth 4.2 m (13.78 ft), flow 365.0 m^3/s (12,888.0 ft^3/s), and velocity of .67 m/s (2.2 ft/s). During the 1987 collection the surface water temperature was 21.6°C (70.9°F), water depth 4.2 m (13.8 ft), flow 437.0 m^3/s (15430.0 ft^3/s), velocity not measured. The larva collected in 1977 was estimated to be 1 to 2 days old while the other larva was estimated to be a few hours old. A third larva was collected on April 3, 1987 at river km 18.7 (river mi 11.6) at a water temperature of 16.1°C (61.0°F), water depth 7.9 m (25.9 ft), flow not measured, and velocity .96 m/s (3.2 ft/s). The larva was estimated to be about 1 to 1.5 days old (FWS 1988).

Huff (1975) spent considerable time using anchored plankton nets to collect Gulf sturgeon eggs and larvae in the Suwannee River but was unsuccessful. However, two Gulf sturgeon eggs were collected in the river on April 22, 1993 (Marchant and Shutters, unpublished manuscript). The eggs were collected in water depths of 5.5 m and 7.3 m (18.0 ft and 24.0 ft) and water temperature 18.3°C (65.0°F) at river km 215 (river mi 134.2), just downstream of the confluence of the Alapaha River. Additional eggs were collected during late March and April 1994 at river km 201 to 221 (river mi 124.9 to 137.3) when water temperatures ranged from 18.8°C to 20.1°C (65.8°F to 68.2°F)(Smith and Clugston, unpublished manuscript). From 1988 through 1992, Gulf sturgeon investigations were conducted throughout the Suwannee River

using plankton nets, small-mesh trap nets, trawls and gill nets, and electrofishing equipment. The smallest Gulf sturgeon collected was a 30.6 cm (12.0 in) specimen weighing 85.0 g (0.2 lb) at river km 215.0 (river mi 133.6) on December 3, 1991 (Clugston et al. 1995).

Stephen Carr and F. Tatman (unpublished data) found that 15 ultrasonic-tagged gravid females were associated with springs between river kms 32.0 and 145.0 (river mi 19.9 and 90.1) in the Suwannee River. The bottom habitats surrounding the springs consist mainly of rock. Their consistent association with these springs has led to Carr's speculation that spawning occurs in these areas.

Remnant reproductive populations may still occur in many small and large rivers draining into the Gulf where Gulf sturgeon have historically ranged. Infrequent anecdotal reports and incidental captures of small Gulf sturgeon indicate that reproduction is occurring in tributary rivers. Small Gulf sturgeon are closely associated with the river basin where they were spawned (river-specific affinity). This has been demonstrated in the Suwannee River and Apalachicola River/Bay distributaries, by the occurrence of similar size Gulf sturgeon in similar depths, and on similar substrate. Any analogous occurrence of small Gulf sturgeon suggests that a reproducing population remains nearby.

Spawning Age

Huff (1975) found that sexually mature females ranged in age from 8 to 17 years and sexually mature males from 7 to 21 years in the Suwannee River. The youngest ripe female specimen and the oldest immature female were age 12. The youngest ripe male specimen was 9 years old and the oldest immature male was age 10. Jenkins (unpublished manuscript) estimated a ripe male captured from the Suwannee River in 1990 to be six to seven years old.

Fecundity

Chapman et al. (1993) reported that three mature Gulf sturgeon had 458,080, 274,680, and 475,000 eggs and were estimated to have an average fecundity of 20,652 eggs/kg (9,366 eggs/lb). Smith et al. (1980) estimated that Atlantic sturgeon weighing 50.0 and 100.0 kg (110.2 and 220.5 lb) would yield over 400,000 and 1,000,000 eggs, respectively.

Gulf sturgeon eggs are demersal and adhesive (Vladykov 1963; Huff 1975; Parauka et al., 1991; Chapman et al., 1993). The eggs are globular and vary in color from gray to brown to black. Smith et al. (1980) reported that Atlantic sturgeon eggs ranged in size from 2.5 to 3.0 mm (0.10 to 0.12 in) in diameter. Parauka et al., (1991) found that eggs from Gulf sturgeon averaged 2.10 and 2.20 mm (0.08 to 0.09 in) in diameter.

Reproduction in Hatcheries

Hormone-induced ovulation and spawning of Gulf sturgeon was accomplished in 1989 at a portable hatchery located on the Suwannee River and at the Welaka National Fish Hatchery in

Florida (Parauka et al., 1991). The project was a joint effort involving the FWS, CCC, and University of California, Davis. The initial spawning produced 5,000 fry for fishery research. In 1990, 1991, and 1992, the University of Florida, the FWS, and CCC again successfully induced spawning and produced about 60,000 fry for fish culture programs. Hatching time for the artificially spawned Gulf sturgeon eggs ranged from 85.5 hr at 18.4°C (65.1°F) to 54.4 hr at about 23.0°C (73.4°F) (Figure 4) (Parauka et al., 1991). Also, at temperatures ranging from 15.6 to 17.2°C (60.1 to 63.0°F) and 19.5 to 21.0°C (67.1 to 69.8°F), eggs hatched in 95 and 65 to 70 hr, respectively (FWS 1991b). Chapman et al. (1993) reported that artificially spawned Gulf sturgeon eggs incubated at 20°C (68°F) hatched in 3.5 days. Hatching time for Atlantic sturgeon eggs has been reported to be 94 hr at 20.0°C (68.0°F) (Dean 1893), 121 to 140 hr at 16.0 to 19.0°C (60.8 to 66.2°F) (Smith et al., 1980) and 168 hr at 17.8°C (64.0°F) (Vladykov and Greeley 1963). One-hour-old Gulf sturgeon larvae, hatched under artificial conditions on the Suwannee River in 1989, ranged in length from 0.66 to 0.71 cm (0.26 to 0.28 in) with a mean length of 0.69 cm (0.27 in) (Parauka et al., 1991). Hatching success ranged from 5 to 10%.

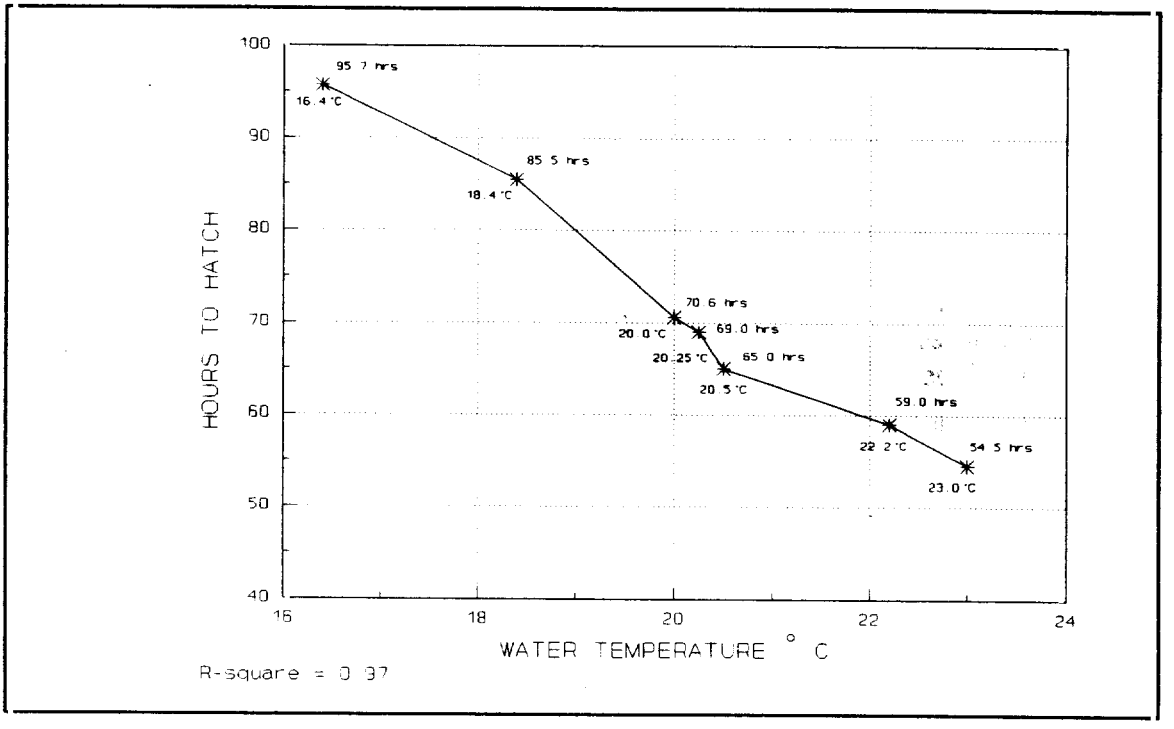

Figure 4: Gulf sturgeon egg incubation periods
at different mean water temperature (F. Parauka et al., 1991; FWS 1991b).

Predator/Prey Relationships

Van Den Avyle (1984) noted there was little written regarding competitors and predators of sturgeon. He pointed out that many fish species live in the same waters as sturgeon and that

there is the possibility for competition with other bottom dwelling species. In fresh water, benthic feeders could compete with young sturgeon or feed directly on eggs and larvae. Competition with Gulf sturgeon for food or space in the marine environment is unknown. Scott and Crossman (1973) speculated that the sturgeon's "size and protective plates protect it from most predaceous fishes and its habitat and secretiveness from other predators."

Parasites and Disease

Fish lice *Argulus stizostethi*, an ectoparasitic copepod, have occasionally been observed on the opercula and gill filaments and in the gut of Gulf sturgeon collected in fresh and estuarine water. The numbers noted were not significant (Mason and Clugston 1993; F. Parauka, personal communication). Endoparasites, such as nematodes, trematodes, and leeches were noted in the guts of Gulf sturgeon (Mason and Clugston 1993). Five species of helminth parasites and one parasitic arthropod have been identified in Atlantic sturgeon from the St. Johns River, New Brunswick (Appey and Dadswell 1978). No detrimental effects from these parasites were noted in these studies.

The shovelnose sturgeon serves as host for glochidia of three mussel species. Rates of glochidial infestation on fish gills are typically low, but thought not to be detrimental to the host (R.S. Butler, personal communication). Huff (1975) reported tumor-like growths on several Gulf sturgeon ovaries from the Suwannee River. Macroscopic tumors were found from 7.5% of gill-netted females in Fall 1972, 3.5% of females in Spring 1973, and 4.6% of females in Fall 1973. Examination of this material revealed two types of growth (Harshbarger 1975). One was a perifollicular pseudocyst (surrounding follicles) filled with proteinaceous fluid often containing viable oocytes. The other type was a parafollicular serous cyst (a true separate fluid-filled cyst) containing denser proteinaceous fluid. Both types are considered subclinical, having little or no effect on adjacent organs, general ovarian development, fecundity, or spawning behavior. Microscopic slides (RTLA nos. 979 and 980) containing this material were accessioned by the Registry of Tumors in Lower Animals, Smithsonian Institution (Huff 1975). Moser and Ross (1993) reported the capture of six Atlantic sturgeon from the Brunswick River, North Carolina from June to September 1991 and in April 1992. Three of the specimen were in poor condition with abnormalities characterized by deformed mouths, lesions of the ventral buccal region and/or lesions around the eye. Oral, buccal, and ventral lesions or ulterations are common signs of poor water quality. Veterinarians examined another sturgeon from the Brunswick River that died without external evidence of disease and found the liver and heart tissues to be in poor condition.

FACTORS CONTRIBUTING TO THE DECLINE AND IMPEDIMENTS TO RECOVERY

Many members of the family Acipenseridae, including Gulf sturgeon, virtually disappeared throughout their ranges at the turn of the 20th century. Their decline was likely caused by over-exploitation and exacerbated by damming of rivers and other forms of habitat destruction and water quality deterioration, among other factors (Birstein 1993; Huff 1975; Barkuloo 1988; McDowall 1988; Smith and Clugston, unpublished manuscript).

Exploitation

The Gulf sturgeon was heavily fished because of the high value of its eggs used to produce caviar and its flesh for smoking (Carr 1983; J. Barkuloo, personal communication). Sturgeon also provided isinglass, a semi-transparent gelatin prepared from the swim bladder and used in jellies, wine and beer clarification, special cements, and glues. Directed commercial fishing contributed to the depletion of sturgeon populations. Aperiodic commercial landing statistics are available from 1887 to 1985 for Gulf sturgeon (Huff 1975; Futch 1984; Barkuloo 1988). Commercial landings data for the Suwannee River are available for 1981 to 1984 (Tatman, unpublished data). These records show that the only consistent fisheries for Gulf sturgeon occurred in west Florida. There was a directed fishery in Alabama, while there is no record of a directed commercial fishery in Mississippi, only incidental catches. Davis et al., (1970) notes a minor commercial fishery for Gulf sturgeon in the Lake Pontchartrain and its tributaries during the late 1960's.

Recreational and subsistence fishing may have contributed to population declines. A "snatch-hook" recreational fishery was popular on the Apalachicola River, Florida, during the late 1950's to 1960's (Burgess 1963; Swift et al., 1977) and continued until 1984 when the State of Florida enacted protective measures.

Incidental Catch

Incidental catch of Gulf sturgeon in other fisheries has been documented (Wooley and Crateau 1985; D. Mowbray, personal communication; H. Rogillio, personal communication). Incidental captures by commercial shrimpers and gill net fishermen in Apalachicola Bay were noted by Wooley and Crateau (1985) and reported by Swift et al. (1977). Such catches have also occurred in Mobile Bay, Tampa Bay, and Charlotte Harbor (J. Roussos, personal communication; FDEP, unpublished data). The FWS caught a small Gulf sturgeon in St. Andrew Bay while gill-net collecting for seatrout for contaminant analysis in 1986 (M. Brim, personal communication). Gulf sturgeon are occasionally caught in Gulf coast rivers on set-hooks targeting catfish (J. Duffy, personal communication). Captures of young Gulf sturgeon have been reported in blue crab traps in the Suwannee River estuary (F. Tatman, personal communication). The incidental catch of Gulf sturgeon in the industrial bottomfish (petfood) fishery in the north-central Gulf of Mexico from 1959 to 1963 was reported by Roithmayr (1965). The bottomfish fishery worked an area between Point au Fer, Louisiana and Perdido Bay, Florida from shore to water depths of about 55 m (180 ft). Hastings (1983) and Moser and Ross (1993) report capture and disruption of spawning migrations of shortnose and Atlantic sturgeon in commercial gill nets targeted for shad in the Cape Fear River, North Carolina.

The LDWF records indicate 177 Gulf sturgeon were incidentally captured and reported by commercial fishermen in southeastern Louisiana during 1992 (H. Rogillio, personal communication). Forty-four of these Gulf sturgeon were delivered to the LDWF field office or held until LDWF employees could secure them. Specimens were generally held in captivity for 1 to 7 days by the fishermen. These sturgeon were then measured, weighed, tagged and

released by departmental personnel. Seventy-six Gulf sturgeon were captured in trawls, 10 in wing nets, and 91 in gill nets. A mortality of less than 1% was noted. This percentage is based on 177 Gulf sturgeon incidentally captured by commercial fishermen and 51 Gulf sturgeon captured by LDWF personnel during a Gulf sturgeon status survey.

Bradshaw (personal communication) reported three tag returns from Gulf sturgeon he collected in early 1985 which were incidentally caught by shrimpers in Mississippi Sound during the fall of that year. He also noted finding three dead Gulf sturgeon incidentally caught by gillnetters in the western part of the Sound and revived another Gulf sturgeon a gillnetter had caught "on" Horn Island in 1989.

Entrainment of *Acipenser guldenstadti* and *A. stellatus* larvae during dredging operations has been assessed by Veshchev (1982) in the lower Volga River, Russia. He concluded that hydraulic dredging operations caused significant mortality of sturgeon larvae in the Caspian basin.

Hastings (1983) reported anecdotal accounts of adult sturgeon being expelled from dredge spoil pipes while conducting a study on shortnose sturgeon on the Atlantic coast. Whether the "adult sturgeon" was an Atlantic or shortnose sturgeon was not indicated in the report.

Habitat Reduction and Degradation

Gulf sturgeon have evolved within Gulf coast drainages that exhibit seasonal patterns of high and low flows, temperature regimes, sedimentation, and other physical factors. Provision of these essential life requirements are part of and dependent on a fully functioning ecosystem.

Dams have limited sturgeon access to migration routes and historic spawning areas (Boschung 1976; Murawski and Pacheco 1977; Wooley and Crateau 1985; McDowall 1988) (Table 1). While sturgeon are able to pass some water control structures, low-head dams, or sills during high water, these structures can create barriers that preclude normal migration. An example of complete migration restriction occurred in the St. Andrew Bay system, Bay County, Florida. A newspaper account from 1895 reports sturgeon were caught at the head of North Bay in upper St. Andrew Bay (Womack 1991). The account notes that an average of three sturgeon a day were caught and 90.7 kg (200 lb) of fish had been smoked and on sale for $0.10 per lb. The FGFC collected four Gulf sturgeon 173.0 to 201.5 cm (68.1 to 79.3 in) in length from Bear Creek, a tributary to Econfina Creek which drains into North Bay, in May of 1961. A dam was placed across North Bay in 1962 preventing anadromous fish migration, and no reports of Gulf sturgeon from above the dam have been reported since that time. Not only was migration to the creeks cutoff, but approximately 2024 hectares (5,000 acres) of estuarine habitat was converted into a fresh water lake.

Another example of complete restriction to Gulf sturgeon migration is the JWLD on the Apalachicola River. Swift et al. (1977) noted a report of a Gulf sturgeon from the Flint River near Albany, Georgia prior to 1950. Huff (1975) noted Gulf sturgeon migrated 322 km

Table 1: Examples of reduction in available river habitat due to dam, water control structure, or sill construction.

River/Watershed	Total River Length	Location of Impediment	Percent Habitat Remaining
St. Andrew Bay Drainage Bear Creek, Lower Econfina Creek, upper North Bay (now known as Deer Point Lake)	11 km (6.8 mi)	Deer Point Dam County Rd 2321	0%
Apalachicola, Chattahoochee, Flint River Basin (to the fall line)	790 km (491 mi)	JWLD river km 172 (river mi 107)	22%
Mobile Bay Drainage Basin Alabama River	1691 km (1051 mi)	Claiborne Dam river km 130 (river mi 81)	8%
Tombigbee River	988 km (614 mi)	Coffeeville Dam river km 121 (river mi 75)	12%
Pearl River	772 km (480 mi)	Ross Barnett Dam (RBD) river km 486 (river mi 302)	63%
During low water conditions		Pools Bluff Sill river km 78.3 (river mi 48.7)	10%
Bogue Chitto River (during low water conditions)	217 km (135 mi)	Boque Chitto Sill river km 6.4 (river mi 4)	3%
Amite River	274 km (170 mi)	control weir river km 40.7 (river mi 25.3)	15%

(200 mi) upstream in the Apalachicola-Chattahoochee-Flint river system before the dam construction in 1957. There are numerous anecdotal reports of Gulf sturgeon in the Flint and Chattahoochee rivers prior to construction of JWLD (Swift et al. 1977). In spite of many tagging studies conducted on the Apalachicola River, no tags have been returned as a result of Gulf sturgeon moving upstream of JWLD, nor does evidence exist that the Gulf sturgeon passes though the lock system (A. Carr, personal communication; U.S. Fish and Wildlife Service, personal communication). The COE (1978) acknowledged that the dam on the Apalachicola River adversely affect Gulf sturgeon by impeding upstream migration.

An example of barriers that limit movement is found in the Pearl River basin above the Pools Bluff and Bogue Chitto Sills. Gulf sturgeon have been reported to be incidentally collected

above the Pools Bluff Sill as far north as the Ross Barnett Reservoir spillway as late as 1984 (J. Stewart, personal communication; R. Jones, personal communication; W. McDearman, personal communication; R. Bowker, personal communication). Based on gauge data (COE, personal communication), the duration of water depths allowing passage of Gulf sturgeon over the sills is limited at the Bogue Chitto Sill and less restrictive at the Pools Bluff Sill (Table 2). It appears Gulf sturgeon movement above the sills is also possible through cutoffs that have developed since the construction of the Pearl River navigation canal (H. Poitevint, personal communication). However, Gulf sturgeon migration is entirely prevented above Jackson, Mississippi by the Ross Barnett Dam at river km 515 (river mi 320). Jones (personal communication) reports that Gulf sturgeon were historically found above this area. He notes the capture of a 154.2 kg (340 lb) female Gulf sturgeon 2.3 m (7.5 ft) from the river 32 km (20 mi) north of Jackson in 1942.

Navigation activities including dam construction, dredging, dredged material, and other maintenance actions could adversely affect Gulf sturgeon habitats depending on the location and timing of the activity. Elimination of deep holes and alterations of rock substrates result in loss of habitat for the Gulf sturgeon in the Apalachicola River (Carr 1983; Wooley and Crateau 1985). At Rock Bluff, river km 148.8 (river mi 92.5), this deep, rocky area frequently used by Gulf sturgeon was filled with dredged spoil material drifting downstream from a within bank disposal site at river km 150 (river mi 93) during routine maintenance dredging. This caused Gulf sturgeon to cease use of this area as a regular habitat (Carr 1983, J. Barkuloo, personal communication). The within bank disposal site is no longer used. Essential habitats of young-of-the-year Gulf sturgeon are unknown, so the impacts of dredging on early life stage habitats of Gulf sturgeon are difficult to assess.

Table 2: Duration Data on Lower Pearl River Sills (COE, personal communication).

Depth Over Sill (m)	Percent Equaled or Exceeded	
	Pools Bluff Sill[1]	Bogue Chitto Sill[2]
.3 m (1.0 ft)	100	90
.61 m (2.0 ft)	70	25
.9 m (3.0 ft)	48	10
1.2 m (4.0 ft)	35	-
1.5 m (5.0 ft)	28	-
1.8 m (6.0 ft)	24	-
2.1 m (7.0 ft)	18	-

[1]Duration based on gauge data for Pearl River at Bogulusa, Louisiana
[2]Duration based on gauge data for Bogue Chitto River at Sun, Louisiana

The entrenchment of the Apalachicola River's streambed due to the trapping of sediments in Lake Seminole, has been attributed to the construction of JWLD (COE 1986). The effects entrenchment occurred in the upper third of the river from the base of the dam to the vicinity of Blountstown, Florida. The streambed elevation lowering was also exacerbated by deepening rock sills, cutting out river bends, and repeated dredging to maintain the channel. This has resulted in elimination of some habitats that had been available to Gulf sturgeon during the summer months prior to the construction of JWLD and navigation channels. For example, as a result of streambed degradation, access to spring-fed tributary creeks has been reduced during low water periods. A cooperative effort by the COE and FGFC removed sedimentation and debris from a midstream spring below the JWLD, navigation km 170.6 (navigation mi 106.0) in January 1994. In addition, the COE obtained environmental clearances and unertook habitat restoration action by the removal of sediments at the mouth of Blue Spring Run, navigation 157.7 (river mi 98.0) in May, 1994.

Cool water habitats are thought to be important to Gulf sturgeon during the summer. Cool-water habitats in streams can be significantly reduced or even eliminated by decreased groundwater levels (Lynn Torak, personal communication). Springs emanating from the streambed originate in the groundwater-flow system and are regulated by relative differences in stream stage, spring-discharge elevation, and groundwater level. Decreased groundwater levels in the vicinity of streams, caused by pumping or climatic variation, can reduce springflow that provides cool-water habitats for the Gulf sturgeon during summer months. Pumping or climate-induced groundwater-level declines can reduce the groundwater component of streamflow (baseflow) in addition to and in the absence of springs. For example, a study in the Albany, Georgia area by Torak et al. (1993) indicates that about 74% of water pumped from the Upper Floridan aquifer in November 1985, approximately 79 million gallons a day, would have discharged to the Flint River under predevelopment conditions. The Flint River is generally unregulated and has a major spring-fed flow component that, in comparison with the Chattahoochee River, contributes the larger share of flow to the Apalachicola River during low-flow periods. The Chattahoochee River is a regulated stream that derives its flow predominantly from surface runoff. Consequently, the Chattahoochee River contributes the major portion of flow to the Apalachicola River during mean- to high-water events. Base-flow of the Flint River has been reduced since the early 1970s, mainly from groundwater and surface water irrigation withdrawals (Leitman et al. 1993). The analysis by Leitman et al. (1993) indicates that the Flint River's percent contribution to the Apalachicola River decreases, instead of increasing as would be expected as the flow in the Apalachicola River decreases. Several springs and spring runs along the upper Apalachicola and Flint Rivers have already exhibited greatly reduced flow or have ceased flowing during periods of drought. If these cool water habitats are important and are reduced in size or eliminated at critical periods of summer, Gulf sturgeon could be subjected to increased environmental stress.

Contaminants may also contribute to population declines. Experiments have shown that DDT and its derivatives and toxaphene are toxic to fish in minute quantities (Johnson and Finley 1980; White et al. 1983). Twelve Gulf sturgeon were collected from the Apalachicola, Suwannee, Choctawhatchee rivers, Ochlockonee Bay and the Gulf of Mexico near Cape San Blas, Florida,

at various times between 1985 to 1991. This specimens were analyzed for pesticides and heavy metals (Bateman and Brim 1994). The Gulf sturgeon ranged in size from 1.8 to 49.0 kg (4.0 to 108.0 lb). Concentrations of arsenic, mercury, DDT metabolites, toxaphene, polycyclic aromatic hydrocarbons, and aliphatic hydrocarbons high enough to warrant concern were detected in individual fish. Specific sources of contamination were not identified. Suwannee River Gulf sturgeon had higher concentrations of arsenic in liver samples than Apalachicola River fish. However, Apalachicola River Gulf sturgeon had higher liver mercury concentrations. Organochlorine pesticides were also highest in fish from the Apalachicola River.

Organochlorines enter the environment as pesticides or industrial waste products. Use of most of these compounds has been prohibited because of effects on nontarget species and suspected carcinogenicity in humans and wildlife. Effects include reproductive failure, reduced survival of young, or physiological alterations which can affect the ability of the fish to withstand stress (White et al. 1983). Levels of DDT and derivative compounds in the samples were found at low concentrations in all Gulf sturgeon tissues, however, DDD and/or DDE was detected in 84% of the samples (Bateman and Brim 1994). In addition, amounts detected in reproductive tissue, while relatively low (range non-detect to 4.02 ppm), could affect Gulf sturgeon reproduction because DDT compounds are known to be estrogenic (Fox 1992). Like DDT, toxaphene is persistent in the environment and biomagnifies through the food chain. Toxaphene was the most heavily used insecticide after prohibition of DDT in the 1970s. Toxaphene was detected in four fish, all from the Apalachicola River. The level of toxaphene in the roe of one specimen was 14.00 ppm wet weight and exceeded the Food and Drug Administration (FDA) action level of 5.00 ppm for fish for human consumption. The highest level in muscle tissue (0.48 ppm) fell below the FDA action level for human consumption (Bateman and Brim 1994). Toxaphene is more toxic to fishes than DDT compounds (Johnson and Finley 1980) and has been shown to impair reproduction, reduce growth in adults and juveniles, and alter collagen formation in fry, resulting in "broken back syndrome" (Mayer and Mehrle 1977).

Polycyclic aromatic hydrocarbons (PAH), primarily from petroleum products, are known to be carcinogenic, cocarcinogenic and tumorigenic. Concentrations found in the ovarian tissue sample (total PAH 410 ppb; Apalachicola River) and eggs (total PAH 409 and 815 ppb; Suwannee River) could adversely affect development and survival of some percentage of eggs, larval, and juvenile fish (Bateman and Brim 1994). Aliphatic hydrocarbons are components of oils, fuels, and other petroleum products. Two or more aliphatic compounds were detected in all tissue samples of the Gulf sturgeon. Hall and Coon (1988) stated that it is likely that any animal with demonstrated petroleum hydrocarbon residues in the tissues has suffered effects of the pollutant (Bateman and Brim 1994).

Arsenic is used in herbicides, insecticides, and fungicides and can be toxic to fish in certain metabolic forms. The metal was detected in 92% of the Gulf sturgeon samples, however the metabolic form was not identified. The arsenic concentrations detected in all of the muscle tissue samples were greater than the FDA action limit of 0.50 ppm for swine muscle tissue (Bateman and Brim 1994).

Mercury, predominantly found as methylmercury in fish fillets, is highly toxic and was detected in 87% of the Gulf sturgeon samples. The mercury concentrations in muscle tissue were well below the Florida limited consumption advisory (0.50 ppm) and the FDA consumptive use action level (1.00 ppm) but, almost all tissue samples exceeded the predator protection limit of 0.10 ppm recommended by Eisler (1987) for the protection of fish-eating birds. However, the mercury levels of the Gulf sturgeon in the study were well below those reported by Armstrong (1979) for other fish species, to cause either chronic inability to catch food, rolling from side to side or acute toxicity.

Cadmium, a known teratogen, carcinogen, and probable mutagen was detected in 42% of the Gulf sturgeon samples. The concentrations were in the low to normal range for muscle and liver tissue when compared to fish species in the Fisheries Resources Trace Elements Survey (FRTES) of the NMFS (Bateman and Brim 1994). Low levels of lead were detected in 8%.

Culture and Accidental or Intentional Introductions

Where viable wild populations exist or sturgeon possibly can be reintroduced, the potential harm from incidental or accidental introduction of non-endemic species is a threat to the genetic integrity and biodiversity of entire ecosystems. The likelihood of these introductions increases dramatically where imports and culture of exotic species is allowed or facilitated, and even where laws or regulations exist which prohibit release of non-endemic species. Accidental releases from culture facilities and intentional releases by aquarists tiring of their hobby is a frequent occurrence. Schwartz (1972, 1981) identifies bibliographic citations of hybrid combinations between species of sturgeons (Acipenseridae). Therefore, an introduction, for example, of white sturgeon from the Pacific coast into Gulf river systems could potentially do great harm to Gulf sturgeon stocks.

An introduction has already occurred in Alabama. A white sturgeon, 50.1 cm (1.6 ft) TL, was caught by a commercial fisherman on a trotline in Lake Weiss, about 2.4 km (1.5 mi) south of Cedar Bluff, Alabama in 1989 (M. Pierson, personal communication). Lake Weiss is part of the upper Coosa River system flowing through Georgia and Alabama. In 1992 a white sturgeon, 96.0 cm (3.15 ft) TL, was caught by a fisherman in the Coosa River east of Birmingham (Sun Herald 1992). This sturgeon was caught about 100 km (62.1 mi) downstream from the 1989 capture. The white sturgeon is thought to have been accidentally released from a private fish hatchery located adjacent to the Coosa River in Georgia. The State of Georgia confiscated the white sturgeon from the hatchery in 1990.

A controversial fishery management problem revolves around the issue of hatchery stocks' adversely affect wild stocks. Hatchery technology has been employed for salmon in the Pacific Northwest for well over thirty years, but salmon stocks in many river systems have recently experienced significant declines. Biologists and many opponents of the hatchery programs attribute these declines on loss of genetic diversity caused by hatchery programs. Proponents of hatcheries argue that the basis of the problem is failure to protect habitat, manage water resources, control harvest, and prevent environmental contamination, among other factors.

These problems and failures may continue to contribute to reductions in stocks of Gulf sturgeon. The problems are readily evident and appropriate actions should be taken to correct them before or in conjuction with introduction of hatchery stock.

Other

Finally, life history characteristics of Gulf sturgeon may complicate and protract recovery efforts. Gulf sturgeon cannot establish a breeding population rapidly because of the long period they require to achieve sexual maturity. Further, Gulf sturgeon appear to be river-specific spawners, although immature Gulf sturgeon occasionally exhibit plasticity in movement or occurrence among Gulf basin rivers. Therefore natural repopulation may be non-existent or very low by Gulf sturgeon migrating from other rivers.

Fishery Management Jurisdiction, Laws, and Policies

The take of Gulf sturgeon is prohibited in the state waters of Louisiana, Mississippi, Alabama, and Florida. Section 6(a) of the ESA provides for extended cooperation with states for the purpose of conserving threatened and endangered species. The Departments of the Interior and Commerce may enter into cooperative agreements with a state, provided the state has an established program for the conservation of a listed species. The agreements authorize the states to implement the authorities and actions of the ESA relative to listed species recovery. Specifically, the states are authorized (1) to conduct investigations to determine the status and requirements for survival of resident species of fish and wildlife (this may include candidate species for listing), and (2) to establish programs, including acquisition of land or aquatic habitat or interests for the conservation of fish and wildlife. Federal funding is also provided to states under the agreements to implement the approved programs. All four of the above mentioned states have entered into Section 6 agreements with the FWS. More detailed descriptions of pertinent agencies, laws, and regulations are provided in Appendix A.

CONSERVATION ACCOMPLISHMENTS

Caribbean Conservation Corporation/Phipps Florida Foundation

1. Initiated tagging of Gulf sturgeon in 1975, using monel tags, in the Apalachicola and Suwannee Rivers which resulted in evidence of home-river fidelity, yearly growth rates, in-river weight loss, and an estimate of population size.

2. Initiated telemetry studies of Gulf sturgeon in 1976, providing evidence of the importance of the Floridian Aquifer to Gulf sturgeon ecology and in-river site fixity.

3. Initiated consultations which resulted in prohibition of take of Gulf sturgeon in the State of Florida.

Gulf States Marine Fisheries Commission

1. Initiated a Gulf sturgeon interjurisdictional fishery management plan in 1990 which evolved into the Gulf Sturgeon Recovery Plan.

National Biological Service, Southeastern Biological Science Center, (BSC-G formerly U.S. Fish and Wildlife Service), Gainesville, Florida

1. Since 1987 conducted comprehensive population and life history studies of Gulf sturgeon in the middle and lower Suwannee River, Florida, in cooperation with the CCC.

2. Facilitated survival and abundance estimates for Gulf sturgeon in the Suwannee River by FWS Resource Analysis Branch using CCC long-term data.

4. Developing relational database on physical, chemical, and biological characteristics of the Suwannee River for use with geographic information system (GIS) software.

5. Evaluating habitat characteristics in areas Gulf sturgeon are known to occupy during the summer months.

6. Conducted studies on movement of hatchery reared Gulf sturgeon released into the Suwannee River.

7. Conducted feasibility study for offshore sonic tracking of Gulf sturgeon.

8. Initiated field sampling in Tampa Bay and the Waccasassa, Steinhatchee, and Ochlockonee rivers to determine presence of Gulf sturgeon and evaluate existing habitat.

9. Provided an analysis of food habits of subadult and adult Gulf sturgeon in the Suwannee River.

10. Provided an assessment of the water quality of the Suwannee River and impacts of natural and human-induced disturbances on the food resources of the Gulf sturgeon.

11. Instituted and maintained a voucher specimen reference collection of Gulf sturgeon foods and provided expert assistance in identification of food organisms.

12. Devised and tested methods for culture of key foods used to rear Gulf sturgeon; amphipod crustaceans, brandling worm, West-African nightcrawler, blackworm, and tubificid oligochaetes.

13. Participated in first artificial spawning of the Gulf sturgeon at a temporary streamside facility in 1989-1991 and in 1992-1993 at the NBS\BSC.

14. Provided the first documented growth of Gulf sturgeon fed natural foods in a laboratory from fry stage to 17 months.

15. Conducted food preference study on cultured juvenile Gulf sturgeon comparing survivorship and growth between live and commercially prepared foods.

16. Identified critical thermal maximum and preferred temperature for cultured juvenile Gulf sturgeon.

17. Conducted investigations into plasma osmotic and metabolic responses to a wide range of experimental salinities.

18. Evaluating the retention rate of passive integrated transponders (PIT tags) and coded wire tags in cultured Gulf sturgeon.

State of Alabama

Alabama Department of Conservation and Natural Resources

1. Established a regulation in 1972 prohibiting all take of sturgeon within the jurisdiction of the State of Alabama.

2. Conducted literature search and field survey in 1991 and 1992 to determine historic and current status of Gulf sturgeon and possible reasons for apparent decline.

3. Conducted sampling of juvenile Gulf sturgeon on the Alabama River from 1990-1992.

4. Conducted feasibility work in 1992 regarding the use of ADCNR's Claude Peteet Mariculture Center in Gulf Shores, Alabama, as a Gulf sturgeon hatchery for the Mobile system.

Alabama Geological Survey

1. Conducted Gulf sturgeon sampling in the Alabama, Mobile, Conecuh, and Choctawhatchee river systems.

State of Florida

Florida Department of Environmental Protection (formerly Florida Department of Natural Resources

1. Conducted an anadromous fish survey, including Gulf sturgeon, in 1970-1971.

2. Completed the first life history study of Gulf sturgeon in the Suwannee River, Florida from 1972-1973.

3. Conducted a status review of Gulf sturgeon in Florida waters in 1984, and recommended prohibition of all take of the species within the jurisdiction of the State of Florida.

Florida Game and Fresh Water Fish Commission

1. Completed F10-R Anadromous Fish Study from 1964-1967.

2. In 1987 listed the Atlantic sturgeon as a Species of Special Concern in: Official list of endangered and potentially endangered fauna and flora in Florida. Florida Game and Fresh Water Fish Commission. 19 pp.

3. In conjuction with the COE, Mobile District, removed sedimentation and debris from a midstream spring below the JWLD on the Apalachicola River, navigation km 170.6 (navigation mi 106.0), to restore important thermal refuge habitat for the Gulf sturgeon and other anadromous species in January 1994.

Florida Marine Fisheries Commission

1. Established a regulation in 1984 prohibiting all take of sturgeon within the jurisdiction of the State of Florida.

University of Florida

1. Artificial propagation of Gulf sturgeon 1991-1995.

State of Mississippi

Gulf Coast Research Laboratory

1. Distributed Gulf sturgeon posters at boat ramps and other appropriate locations during 1992 in order to acquire information and reports on Gulf sturgeon sightings.

Mississippi Department of Wildlife, Fisheries, and Parks

1. Established a regulation in 1974 prohibiting all take of sturgeon within the jurisdiction of the State of Mississippi.

2. Listed the sturgeon as an endangered species in 1974.

3. Conducted Gulf sturgeon investigation and documentation in the Pascagoula River during 1993.

Mississippi State University

1. Documented Gulf sturgeon presence in the lower Pearl River in 1985 and 1988.

2. Documented incidental catches of Gulf sturgeon in Mississippi in 1989.

3. Investigated and documented Gulf sturgeon in the Pascagoula River in 1993.

State of Louisiana

Louisiana Department of Wildlife and Fisheries

1. Initiated a survey in 1990 to assess the status of Gulf sturgeon in Louisiana waters.

2. Initiated a radio-tracking project in 1992 on Gulf sturgeon in the Pearl River drainage and continuing into 1994.

3. Established a computerized data base in 1991 on all pallid and Gulf sturgeon sightings and captures in Louisiana and continues to be updated as needed.

4. Conducted Gulf sturgeon tagging using T-bar and monel tags beginning in 1992 and ongoing in 1994.

5. Collected blood and tissue samples for genetic analysis beginning in 1991 and ongoing in 1994.

6. Established a regulation in 1990 prohibiting all take of sturgeon within the jurisdiction of the State of Louisiana.

State of Texas

Texas Parks and Wildlife Department

1. Conducted sampling for sturgeon in the Rio Grande in 1992 - 1993.

2. Documented historic distribution of sturgeon in Texas.

U.S. Army Corps of Engineers, Mobile District, Mobile, Alabama

1. Restored access into Battle Bend Cutoff on the Apalachicola River, approximate river km 46.3 (river mi 28.8) in 1987.

2. Conducted flow/velocity studies below the JWLD to document velocities in Gulf sturgeon habitat areas during low flow conditions during November 1991 and October 1992, as

part of a Biological Assessment associated with the Jim Woodruff Powerhouse Major Rehabilitation Evaluation Report.

3. In conjuction with the FGFC, removed sedimentation and debris from a midstream spring below the JWLD on the Apalachicola River, navigation km 170.6 (navigation mi 106.0), to restore important thermal refuge habitat for the Gulf sturgeon and other anadromous species in January 1994.

4. Obtained environmental clearances and undertook action to restore habitat for the Gulf sturgeon and other anadromous species by removal of sediments at the mouth of Blue Spring Run, Apalachicola River, navigation km 157.7 (river mi 98.0) in March 1994, under the Department of the Army/National Oceanic and Atmospheric Administration Cooperative Agreement to Create and Restore Fish Habitat.

5. Initiated Anadromous Fish Hatchery Reconnaissance Study in 1987.

6. During January 1994, the COE proposed that the Waterways Experiment Station (WES) consider in the FY 1995 Environmental Impact Research Program (EIRP) a proposal to document issues affecting the protection of sturgeon related to O&M activities in North American rivers. This proposal was submitted because of similar concerns expressed by other COE divisions and districts that operation and maintenance (O&M) projects may impact sturgeon populations. It is also proposed to quantify responses of sturgeon to broad ranges of relevant physical conditions so that risk from O&M activities can be predicted. Districts will be surveyed for specific issues on sturgeon and the scope of problems will be defined. The District has been informed from COE headquarters that funds are available for WES to initiate efforts in FY 1995.

U.S. Army Corps of Engineers, Vicksburg District, Vicksburg, Mississippi

1. Funded a study conducted by WES on Gulf sturgeon in the Pearl River during 1994 and 1995.

U.S. Fish and Wildlife Service

Fisheries Resources Office, Panama City Field Office, Florida

1. First documented in-river habitat usage of Gulf sturgeon in 1977.

2. First documented Gulf sturgeon spawning in the Apalachicola River, Florida in 1977.

3. Investigated methods of externally marking Gulf sturgeon beginning in 1981.

4. Documented the movement of Gulf sturgeon in the Apalachicola River using radio and sonic telemetry devices beginning in 1982.

5. Estimated the Gulf sturgeon population size in the Apalachicola River below JWLD beginning in 1983.

6. Reviewed and validated the morphometric characteristics used in the taxanomic separation of Gulf and Atlantic sturgeon in 1985.

7. Developed field techniques and equipment which aided in the handling of Gulf sturgeon in 1985.

8. Investigated the age structure of Gulf sturgeon in the Apalachicola River by utilizing cross-sections from pectoral fin rays beginning in 1986.

9. Initiated artificial propagation of Gulf sturgeon in 1989.

10. Collected samples for and funded genetic studies on Gulf sturgeon throughout their range beginning in 1990.

11. Collected samples for and funded contaminant tissue analyses of Gulf sturgeon from the Apalachicola and Suwannee rivers, Florida beginning in 1990.

12. Initiated a program through news releases and information posters to document Gulf sturgeon sightings (past and present) from Tampa Bay, Florida to the Mississippi River in 1992.

13. Funded development of a dual radio-sonic telemetry tag in 1992.

14. Compiled and maintained a directory/data base of sturgeon and paddlefish researchers beginning in 1992.

17. Produced a report entitled Gulf Sturgeon Sightings, Historic and Recent - a Summary of Public Responses in 1993.

18. Conducted field investigations to develop a population model for the Gulf sturgeon and to delineate riverine habitat requirements in 1993 and 1994, in cooperation with the NBS, North Carolina Cooperative Fish and Wildlife Research Unit.

Ecological Services, Panama City, Florida

1. Funded preparation of an information report on the Gulf sturgeon, entitled: Gulf of Mexico Sturgeon, *Acipenser oxyrhynchus* (Vladykov), Information. 1980. Unpublished. 15 pp. J.L. Hollowell.

2. Completed a document entitled: Report on the Conservation Status of the Gulf of Mexico Sturgeon *Acipenser oxyrhynchus desotoi* in 1988.

3. Prepared report entitled, Reconnaissance Report on the Feasibility of Constructing an Anadromous Fish Hatchery Apalachicola River, Florida for the COE, Mobile District in 1989.

4. Initiated the proposal to list the Gulf sturgeon under the ESA.

5. Coordinated development of Gulf Sturgeon Management/Recovery Plan from 1992 to 1995.

Ecological Services, Jacksonville, Florida

1. Prepared the listing package to list the Gulf sturgeon as a threatened species under the ESA (listed September 30, 1991 in conjuction with the Department of Commerce-NOAA).

Ecological Services, Jackson, Mississippi

1. Produced a Mobile River Basin Aquatic Ecosystem Recovery Plan in 1995.

Warm Springs Regional Fisheries Center, Georgia

1. Developed Gulf sturgeon artificial feeding program in 1989.

Welaka National Fish Hatchery, Florida

1. Hormone induced spawning of Gulf sturgeon beginning in 1989.

2. Developed Gulf sturgeon artificial feeding program in 1989.

Gulf Coast Fisheries Coordination Office, Ocean Springs, Mississippi

1. Participated as a technical advisor in development of the Gulf sturgeon Management/Recovery Plan from 1992 to 1995

Memorandum of Understanding (MOU) on Implementation of the Endangered Species Act.

Fourteen federal agencies including the COE, NMFS, FWS, NPS, DOD, MMS, CG and EPA signed the MOU in September of 1994. The purpose of the MOU was to establish a general framework for cooperation and participation among the agencies in accordance with responsibilities under the ESA. The agencies are to work together along with appropriate involvement of the public, states, Indian Tribal governments, and local governments, to achieve the common goal of conserving species listed as threatened or endangered under the ESA by protecting and managing their populations and the ecosystems upon which those populations

depend. The cooperating federal agencies involved in recovery of the Gulf sturgeon will now be able to work closer together under the umbrella of this MOU.

II. RECOVERY AND FISHERY MANAGEMENT

OBJECTIVES AND CRITERIA

Objectives constitute those results that are desired to be attained through implementation of the Recovery Plan. Criteria are those factors that define how attaining the objective will be pursued, and what will constitute sucess.

1. Short-term Objective: The short-term recovery objective is to prevent further reduction of existing wild populations of Gulf sturgeon within the range of the subspecies. This objective will apply to all management units within the range of the subspecies. Ongoing recovery actions will continue and additional actions will be initiated as needed.

   Criteria:

   A. Management units will be defined using an ecosystem approach based on river drainages. This approach may also incorporate genetic affinities among populations in different river drainages.

   B. A baseline population index for each management unit will be determined by fishery independent catch-per-unit-effort (CPUE) levels.

   C. Change from the baseline level will be determined by fishery independent CPUE over a three to five year period. This time frame will be sufficient to detect a problem and to provide trend information. The data will be assessed annually.

   D. The short-term objective will be considered achieved for a management unit when the CPUE is not declining (within statistically valid limits) from the baseline level.

2. Long-term Objective A: The long-term recovery objective is to establish population levels that would allow delisting of the Gulf sturgeon by management units. Management units could be delisted by 2023 if the required criteria are met. While this objective will be sought for all management units, it is recognized that it may not be achievable for all management units.

   Criteria:

   A. The timeframe for delisting is based on known life history characteristics including longevity, late maturation, and spawning periodicity.

   B. A self-sustaining population is one in which the average rate of natural recruitment is at least equal to the average mortality rate over a 12-year period (which is the approximate age at maturity for a female Gulf sturgeon).

C. This objective will be considered achieved for a management unit when the population is demonstrated to be self-sustaining and efforts are underway to restore lost or degraded habitat.

3. Long-term Objective B: This is a long-term fishery management objective to establish, following delisting, a self-sustaining population that could withstand directed fishing pressure within management units. Note that the objective is not necessarily the opening of a management unit to fishing, but rather, the development of a population that can sustain a fishery. Opening a population to fishing will be at the discretion of state(s) within whose jurisdiction(s) the management unit occurs. As with Long-term Objective A, this objective may not be achievable for all management units, but will be sought for all units.

Criteria:

A. All criteria for delisting must be met.

B. This objective will be considered attained for a given management unit when a sustainable yield can be achieved while maintaining a stable population through natural recruitment.

C. Particular emphasis will be placed on the management unit that encompasses the Suwannee River, Florida, which historically supported the most recent stable fishery for the subspecies.

These objectives and criteria are preliminary. After better identification of population status and evaluation of the adequacy of the habitat to support self-sustaining populations, these objectives and criteria may be revised. The criteria stated above will be more quantitatively defined through identification of management units and through population assessments in those individual management units.

OUTLINE FOR RECOVERY ACTIONS ADDRESSING THREATS

Recovery Outline Narrative

1.0 Determine essential ecosystems, identify essential habitats, assess population status, and refine life history investigations in management unit rivers.

As an initial step to enhance the long-term recovery of populations of Gulf sturgeon, collection of basic biological information is essential. Without a clear understanding of life history requirements, recovery efforts are severely hampered. Presently, lack of information in the marine environment and sparse information in the riverine environment make it difficult to adequately census populations or to implement appropriate recovery actions. Studies to provide this information should be conducted as soon as possible.

1.1 Identify essential habitats important to each life stage in river basin and contiguous estuarine and neritic waters.

Investigations are needed to locate and describe the micro- and macrohabitat characteristics critical for recovery and maintenance of the Gulf sturgeon. Radio and ultrasonic tracking studies of juveniles and adults will help determine movements and habitat utilization over time. Emphasis should be placed on tracking Gulf sturgeon in the estuarine and marine environment where it is believed that most feeding and growth occurs, and where the least information is available. Spawning areas and larval and post-larval movements and distribution within rivers must be determined. When a sufficient number of animals has been monitored and distributions identified, habitat characterization studies can be used to better define essential habitat requirements. Significant ecosystems for the recovery of the Gulf sturgeon will be identified once essential habitats are defined in riverine, estuarine, and marine environments

1.1.1 Conduct and refine field investigations to locate important spawning, feeding, and developmental habitats.

Gulf sturgeon have been successfully tracked with radio and ultrasonic transmitters in riverine systems. These studies have been limited to a very few locations, and usually for a short time spans. Multi-year tracking studies in the estuarine and marine environment have never been accomplished. Knowledge of spawning areas, developmental habitat requirements and feeding requirements are essential to the recovery of Gulf sturgeon in all river basins across the range of the species. Tracking studies appear to be the best way to initially locate important habitat. Technological advances in telemetry should facilitate long-term tracking studies to provide the needed information. The FWS and NBS should expand their efforts to identify and inventory essential habitats of Gulf sturgeon. The Gulf states resource management agencies should continue or initiate studies to identify essential habitats in their respective states. The CCC should continue their multi-year monitoring

program on the Suwannee River. New field work by other researchers such as universities and non-government organizations (NGOs) should incorporate this research need into their plans. The NMFS should work with FWS and NBS to identify marine habitats used by adult Gulf sturgeon during winter migration. The MMS should seek funding to obtain this information because of the potential for impacts to the Gulf sturgeon from outer continental shelf oil and gas operations and other non-energy mineral mining activities.

1.1.2 Characterize riverine, estuarine, and neritic areas that provide essential habitat.

When areas of utilization have been delineated (Task 1.1.1), characterization of these habitats should be conducted. Characteristics of the areas regarding particular life history requirements of Gulf sturgeon at various life stages must be determined. Among the parameters that may be important include substrate, depth, instream flow, current, pH, temperature, turbidity, and food availability. The Gulf states resource management agencies, FWS, NMFS, NBS, CCC, NGOs, and universities should refine their studies or surveys to provide these data.

1.2 Conduct life history studies on the biological and ecological requirements of little known or inadequately sampled life stages.

Because of the difficulty in collecting eggs, larvae, and adequate numbers of Gulf sturgeon less than a year old, essentially nothing is known about requirements of these life stages in the wild. Year-class strength is established during these stages, and water temperature, salinity, flow, turbidity, and other factors affect survival rates. As outlined in Task 1.1, intensive field investigations must be initiated to locate and characterize habitats used by early life stages. Likewise laboratory studies on wild and cultured Gulf sturgeon must be conducted to evaluate habitat requirements and tolerances. The University of Florida, NBS, and FWS should expand ongoing investigations into the biology and ecology of Gulf sturgeon. Non-fatal sampling techniques to examine stomach contents need to be determined. Diet studies of fish captured in estuaries should be expanded. Diet of Gulf sturgeon captured offshore (neritic environments) should also be evaluated, not only to assess food preferences, but also to determine habitat use.

It is known that subadult and adult Gulf sturgeon spend winters feeding in estuarine and marine waters. Little is known about specific areas and habitat requirements. Ultrasonic techniques should be improved and studies conducted to document marine habitats frequented by Gulf sturgeon. Identified habitats must be described by depth, water quality, substrate, and food availability. The FWS and NBS should continue ongoing marine habitat investigations of Gulf sturgeon. The NMFS should initiate marine habitat investigations of Gulf sturgeon.

1.3 Survey, monitor, and model populations.

Intensive field investigations have concentrated on Gulf sturgeon life history in the Suwannee and Apalachicola rivers in Florida. Additionally, long-term monitoring of Gulf sturgeon in these systems has resulted in reliable population estimates with which population models are being developed. Outside these systems, few studies have been conducted on the Gulf sturgeon. Information such as distribution, relative abundance, age structure and other biological information should be compiled to identify baseline population status and identify index monitoring sites to evaluate success of recovery and management programs.

1.3.1 Develop and implement standardized population sampling and monitoring techniques.

The assessment of Gulf sturgeon populations Gulfwide are essential to develop and evaluate recovery and management efforts. Standardized programs to address size, age and sex composition, and stock size must be developed so that the condition of each stock can be evaluated over time and compared with those in other river systems. Government agencies, NGOs, and universities investigating Gulf sturgeon should participate in a coordinated effort to develop standardized sampling and monitoring techniques and conduct appropriate programs. Standard operating procedures will facilitate application of statistical data set comparisons between various Gulf coast river systems. In addition, fishery management/recovery decisions could be more accurately formulated with uniform data collection and reporting procedures. The FWS should take the lead in coordinating, preparing and distributing a standardized sampling and monitoring protocol document. The Gulf states resource management agencies should evaluate the status of populations of Gulf sturgeon in their streams and coastal waters. The FWS and NBS in conjunction with other researchers should verify current aging techniques for Gulf sturgeon.

1.3.2 Develop population models.

Modeling is needed to better assess fishery restoration and management options. Capture-recapture models can estimate survival, abundance and recruitment of Gulf sturgeon. Population models should be developed to forecast the future condition of Gulf sturgeon populations and provide estimates on potential rates of recovery. Appropriate models will also help identify future research needs. The FWS and NBS should continue to take the lead in formulating peer accepted population models for the Gulf sturgeon.

1.4 Continue experimental culture of Gulf sturgeon.

Successful artificial propagation of Gulf sturgeon was first accomplished in 1989. Additional work is still needed to refine culture techniques, develop handling and holding procedures for fry and broodstock, maintaining genetic diversity of broodstock, research

nutritional requirements and initiate fish health management. In addition, research is needed to document the optimum chemical and physical parameters necessary for maintaining growth and survival of Gulf sturgeon under artificial and natural conditions.

1.4.1 Continue culture of Gulf sturgeon.

State, federal, and NGOs should continue to develop culture techniques for Gulf sturgeon in accordance with the Gulf Sturgeon Hatchery Guidelines, Hatchery Manual for White Sturgeon protocols addressed in the Gulf Sturgeon Recovery Plan, and state and federal laws and regulations. Efforts should be directed towards filling data gaps (i.e. hormone dosages and types, incubation temperatures, egg de-adhesion methods, broodstock reproductive staging, elimination of stress related to capture, handling, and holding, among other factors).

1.4.2 Identify the physical, chemical and biological parameters necessary to maintain growth, health and survival of Gulf sturgeon reared under artificial conditions.

Studies are needed to determine the optimum water quality conditions necessary to maintain growth and survival of fry and fingerlings. In addition, nutritional requirements and artificial feeding methods need to be identified. Research is required to document carrying capacity for various fish rearing facilities, and hauling densities of fry and fingerlings. The FWS, researchers, and universities should continue to implement additional studies to address this need. Also, the FWS should take the lead in providing updated information on artificial propagation of Gulf sturgeon.

1.4.3 Identify and test internal and external markers or techniques useful for differentiation of wild and hatchery-produced Gulf sturgeon.

The identification of non-genetic internal and external markers to differentiate between wild and hatchery-produced Gulf sturgeon is important in the development and regulation of hatchery programs. Unique markers (i.e. PIT tags, coded wire tags, and chemical marking) could allow investigators, law enforcement officers, and others to distinguish hatchery-reared fish from wild stocks. In addition, these markers or techniques may be used in selective enhancement programs and provide a means to evaluate introductions. The FWS and other researchers should continue to investigate and develop useful internal and external markers or techniques.

1.5 Identify genetic characteristics of wild and hatchery-reared Gulf sturgeon.

Research is needed to determine whether or not significant genetic differences exist among Gulf sturgeon from throughout the range of the subspecies. Determining whether genetic differences exist among populations is essential to ensure successful recovery and

management of the subspecies. Genetically distinct management units may be identified and could affect reintroduction and/or population augmentation.

1.5.1 Conduct a Gulfwide genetic assessment to determine geographically distinct management units.

Determination of the genetic structure for Gulf sturgeon is essential in formulating future management decisions for the subspecies. It is important that sound restoration efforts of Gulf sturgeon address the genetic structure of the subspecies in order to identify and maintain genetic integrity and diversity. Mitochondrial DNA analysis of Gulf sturgeon should be continued with emphasis placed on obtaining Gulf sturgeon tissues and/or blood from the following river systems:

1. Pascagoula River, Mississippi.
2. Mobile and Alabama rivers, Alabama.
3. Ochlocknee River, Florida.
4. Escambia River, Florida.

A genetic tissue bank should be established and curated where state or federal agencies deposit tissue or blood for genetic analysis. The Gulf states resource management agencies, universities, NGOs, NBS, FWS, and other Gulf sturgeon researchers should establish tissue collection protocol and insure that tissue samples are collected whenever possible.

1.5.2 Assess the potential to develop genetic markers to differentiate wild and hatchery-produced Gulf sturgeon.

The development of genetic markers for differentiating between wild and hatchery produced Gulf sturgeon may be important in the development and regulation of hatchery programs. A unique genetic marker could allow investigators, law enforcement officers, and others to distinguish hatchery reared fish from wild stocks. In addition, hatchery stocks possessing a different genetic mark from wild fish may be used in selective enhancement programs and provide a means to evaluate their introductions. The FWS and NMFS should continue to investigate the potential of viable genetic markers.

2.0 Protect individuals, populations, and their habitats.

In efforts to recover listed species, protection is the most obvious initial step. By virtue of their endangered or threatened status, species may not be able to sustain continuing losses of individuals, and steps should be taken immediately to eliminate any known preventable take. Initial measures to protect individuals, populations, and their habitats can be strengthened or reduced as new information is collected.

2.1 Reduce or eliminate unauthorized take.

Under the ESA, take means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." "Harm" in the definition of "take" in the ESA means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. "Harm" in the definition means an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. In the case of the Gulf sturgeon, the immediate concern is with lethal or injurious take by non-directed fisheries. Directed fisheries for listed species are prohibited by virtue of the listing. However, a number of fisheries targeting other species use fishing gear that take Gulf sturgeon.

2.1.1 Increase effectiveness and enforcement of state and federal take prohibitions.

Directed take of the Gulf sturgeon is prohibited under the ESA and laws or regulations of Louisiana, Mississippi, Alabama, and Florida. All states within the geographic distribution of the Gulf sturgeon have cooperative agreements with the FWS that require enforcement of federal endangered species laws. Both federal and state officials are empowered to enforce prohibitions on the take of Gulf sturgeon. Appropriate steps should be taken to support and enhance enforcement activities related to restoration and protection of Gulf sturgeon. The Gulf states resource management agencies should evaluate their enforcement programs and if needed, implement appropriate enhancements or actions. The FWS and NMFS should insure that during ESA section 7 consultations, incidental take is stipulated to provide full protection of the species.

On July 1, 1975, the Atlantic sturgeon (*Acipenser oxyrinchus*, including the Gulf sturgeon) was included in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The effect of this listing is that CITES permits are required before international shipment may occur.

2.1.2 Reduce or eliminate incidental mortality.

Incidental catch and mortality of Gulf sturgeon is a difficult or cryptic problem to address because it requires a knowledge of effort and catch composition in a variety of different fisheries. Gear types used in many fisheries are capable of capturing Gulf sturgeon, and it is essential that the magnitude of the problem in each fishery is known before effective steps can be taken to reduce or eliminate mortality. A limited observer program may be needed to evaluate the amount/extent of incidental take or mortality in some fisheries and navigation-related and other activities. When

problem fisheries or other activities have been identified, gear or equipment modifications, seasonal restrictions, limited gear or equipment deployment times, and other measures may be employed to reduce mortality of Gulf sturgeon and allow the affected fisheries or other activities to continue to operate.

If incidental take is found to be related to any fishery, the NMFS and the Gulf states should promulgate adequate regulations that protect the Gulf sturgeon from such incidental take. The NMFS should also evaluate Turtle Excluder Devices (TEDs) in commercial shrimp nets to determine if they are effective in allowing Gulf sturgeon to escape from trawls. If they are not effective, funding should be sought to investigate the appropriate gear technology. The NMFS should also fund an observer program, enforcement of regulations, and other necessary actions which reduce or eliminate incidental take of Gulf sturgeon during fishing operations.

In addition, the NMFS and FWS in cooperation with the responsible federal agency should develop methodologies that would cause Gulf sturgeon to avoid areas during navigation-related (includes O&M) activities, Clean Water Act (CWA) Sections 10 and 404, or other construction activities. The NMFS and FWS should assure that the objective of ESA section 7 consultation is to reduce or eliminate incidental take during such activities. As an example, section 7 consultation for a dredging project may result in the COE permitting the activity to occur only during seasons when Gulf sturgeon are not present in the action area.

2.2 Identify and eliminate known or potentially harmful chemical contaminants, and water quantity and water quality problems which could impede recovery of Gulf sturgeon.

Chemical contaminants, water quantity, and water quality factors may have contributed to the decline or are limiting the recovery of Gulf sturgeon. These factors include pesticides (organochlorines), metals (lead, mercury, etc.), industrial byproducts, temperature, pH, suspended solids, dissolved oxygen, water depth, and water velocity. Review of existing data and information is necessary to refine or identify the chemical and water quality and quantity requirements of Gulf sturgeon.

An information search for each management unit or coastal habitat area regarding potential types of chemical contaminant loading, including chemicals from point sources, agriculture, silviculture, industrial activities and urbanization, should be conducted. Existing chemical contaminant field evaluation reports (water, sediment or biota studies) should be examined and the information utilized to make decisions related to field sampling and chemical analysis. Field sampling of water, sediments, and sentinel and/or surrogate species should be conducted, as necessary, to fill critical information gaps. State agencies in Louisiana, Mississippi, Alabama, and Florida, with assistance from the Environmental Protection Agency (EPA) and FWS should collect existing information and provide an assessment report with recommendations. The FWS should provide coordination between the federal and state agencies as needed, compile state reports, and identify a consensus priority listing

of chemical contaminant sources that may have impacts on Gulf sturgeon in the river systems. The EPA "Priority Pollutants" for each management unit or habitat area should be assessed by chemical analyses for Gulf sturgeon and other benthic species. The FWS and EPA, using the compiled contaminant data, should prepare the list and conduct necessary analyses.

2.2.1 Identify potentially harmful chemical contaminants and water quality and quantity changes associated with surface water restrictions.

A comprehensive inventory of river basins with existing surface water restrictions is needed to document physical and biological impacts that may negatively affect recovery and management of Gulf sturgeon. The GSMFC, FWS, and COE should coordinate preparation of this inventory with GSMFC taking the lead for final product completion.

2.2.2 Identify and eliminate potentially harmful point and non-point sources of chemical contaminants.

Significant point sources and high-impact non-point source areas of contaminant introductions should be identified. Appropriate actions to reduce or eliminate the contaminants should be taken. With the results of 2.2.1, EPA and state agencies in Louisiana, Mississippi, Alabama, and Florida should take actions to enforce existing regulations or promulgate new ones.

2.2.3 Assess selected contaminant levels in Gulf sturgeon from management units.

Gulf sturgeon tissue analyses should be conducted to evaluate selected chemical contaminants. Appropriate actions should be taken to reduce or eliminate contaminant sources. The EPA should take the lead in efforts to reduce or eliminate identified contaminant sources through their regulatory authorities. The EPA could also assist state agencies in Louisiana, Mississippi, Alabama, and Florida in enforcement of state regulations. During the Triennial Review of state water criteria, EPA should ensure that the states have incorporated adequate water quality standards to protect the Gulf sturgeon and its benthic habitat.

Routine, standardized inspections should be conducted on all incidental catches of Gulf sturgeon (alive or dead) for the presence of gross lesions, tumors or other abnormalities to focus evaluation on chemical contaminants.

Histopathological examinations of liver tissue for cases of incidental Gulf sturgeon mortalities should be conducted to detect the presence of cellular abnormalities or carcinogenic cells.

Chemical analyses of selected tissues should be conducted from incidental mortalities of Gulf sturgeon. The FWS should take the lead in developing protocol to collect samples, conduct training if necessary, process samples for analyses, and prepare summaries of results. Wherever possible, Gulf state resource management agencies should conduct similar analyses.

Appropriate surrogate species should be utilized to better define bio-accumulation of contaminants in particular river basins. An extrapolation formula for estimating potential chemical contaminant impacts to Gulf sturgeon should be developed. The FWS and EPA should lead the efforts to identify appropriate surrogate species, conduct bio-accumulation studies, and develop an extrapolation formula. Appropriate peer review should be conducted during formula development.

2.2.4 Identify and eliminate known and potential impacts to water quantity and quality associated with existing and proposed developments, agricultural uses, and water diversions in management units.

Domestic and industrial effluent, rural and urban run-off, and inter- and intra-water diversions affect the clarity, pH, biological oxygen demand, nutrient and contaminant composition, temperature, sediment loads, and seasonal quantity of river waters. A comprehensive inventory of known or potential problem areas associated with these factors is needed. Once identified, actions to reduce or eliminate problems and promote wise land use should be taken. With the results of 2.2.1, EPA and Gulf states resource management agencies should take actions to enforce existing regulations or promulgate new ones.

Water quality and sediment factors resulting from point and nonpoint sources may negatively affect Gulf sturgeon habitat. Examples include total dissolved solids, suspended solids, turbidity, siltation, pH, temperature, and changes in sediment types. Studies to assess the effect of river water and sediment quality should be conducted to determine the habitat suitability for Gulf sturgeon.

2.2.5 Assess the relationship between groundwater pumping and reduction of groundwater flows into management units, and quantify loss of riverine habitat related to reduced groundwater in-flows.

Groundwater diversions which affect flows into management unit rivers should be identified. The loss of riverine groundwater flows attributed to diversions should be quantified and its effect on Gulf sturgeon evaluated. The U. S. Geological Survey (USGS) should take the lead in implementing appropriate studies including modelling. The Tri-State Study for the Alabama-Tallapoosa-Coosa and Apalachicola-Chattahoochee-Flint river basins funded by the COE and Alabama, Georgia, and Florida should incorporate an effort to provide a preliminary

assessment of the effects of groundwater pumping into the groundwater scope of work plan.

2.2.6 Conduct studies to determine the effects of known chemical contaminants in water from management unit rivers on Gulf sturgeon or a surrogate species.

After identification of priority contaminants, physiological and behavioral responses of Gulf sturgeon life stages to long-term exposures to such chemicals should be determined. In particular, newly fertilized eggs, Gulf sturgeon larvae, and juvenile Gulf sturgeon should be tested. The EPA should work with the FWS to conduct bioassays of water from the management unit rivers to determine effects on Gulf sturgeon.

2.3 Develop a regulatory and/or incentive framework to ensure that essential habitats, streamflow, and groundwater in-flows are protected.

Where existing laws and regulations are inadequate to meet recovery objectives, appropriate state and federal agencies should propose new incentives, laws, and/or regulations.

2.3.1 Utilize existing authorities to protect habitat and, where inadequate, recommend new incentives, laws, and regulations.

The ESA provides for the protection and recovery of the Gulf sturgeon and its habitats. Likewise individual Gulf states have regulations and laws for that purpose. Adequate funding levels must be provided to enforce existing protection measures and laws. Federal and state natural resource law enforcement programs are understaffed and underbudgeted to adequately enforce laws protecting the Gulf sturgeon and its habitats. Even with adequate funding, existing authorities may be inadequate to fully protect the Gulf sturgeon and its habitats. Adoption of new incentives, laws or regulations may be necessary to ensure the recovery of the species. Protection measures should be based on the biological requirements of the subspecies and not political boundaries. The FWS should ensure protection of the Gulf sturgeon through the ESA section 7 consultation process with other federal agencies including the COE (federal projects, Section 10/404 permits), MMS (OCS oil and gas lease sales), EPA (National Pollutant Discharge Elimination System permits, Triennial Review).

2.3.2 Identify, protect and/or acquire appropriate land or aquatic habitats on an ecosystem approach.

Habitat components of the Gulf sturgeon which provide essential life requirements should be considered as part of and dependent on a fully functioning ecosystem . These ecosystems should be protected and/or acquired. The Gulf states resource management agencies, FWS, and NMFS should seek appropriate avenues of funding

and take action to acquire, manage, and protect identified significant habitats or their ecosystems as appropriate.

For example, spawning habitats should receive maximum protection from disturbance. In order to protect specific habitats, the ecosystem where it occurs also requires protection. Thus, protection of spawning habitats of the Apalachicola River would include the upper 20 km (12.4 mi) of the river and its surrounding basin components. Another example includes the maintenance of habitats such as the springs that occur in the Suwannee River. To protect these springs, it is essential to maintain other ecosystem components including upstream water quality, groundwater flows and quality, and adjacent floodplains.

2.4 Restore, enhance, and provide access to essential habitats.

Gulf sturgeon have evolved within Gulf coast drainages exhibiting seasonal patterns of high and low flows, temperature regimes, sedimentation, and other physical factors which historically may have been much different than those which exist today. The restoration and enhancement of some river and stream habitats, particularly benthic habitat, within the historical range of the Gulf sturgeon may be necessary before its recovery is successful. Within some drainages, man's alterations (mainstem dams, low-head diversions) may be preventing Gulf sturgeon from gaining access to important habitats essential to some aspect of its life history. If such structures are identified as impeding migration or preventing access to critical habitats, action should be taken to restore the natural hydrography or provide a viable bypass route around the structure.

2.4.1 Identify dam and lock sites that offer the greatest feasibility for successful restoration of and to essential habitats (i. e., up-river spawning areas).

Mainstem and low-head diversion dams that are known to be impeding potentially viable Gulf sturgeon populations from reaching historically essential habitats need to be identified. The extent of important habitat types upstream from such structures (e.g., potential spawning sites and summer refugia) should be evaluated.

The GSMFC should take the lead in identifying these sites throughout the Gulf states and preparing summary and recommendations. Federal and non-federal permitted dams should be identified. The COE, FERC, and entities such as the Pearl River Valley Water Supply District should investigate ways of mitigating impacts of federal and private water resource projects or permitted activities on Gulf sturgeon populations.

2.4.2 Evaluate, design, and provide means for Gulf sturgeon to bypass migration restrictions within essential habitats.

The structures preventing upstream migrations to essential habitats should be modified or removed to allow for Gulf sturgeon passage. Specific modifications will depend on the type of obstruction, river hydrology and the importance of the habitat to the recovery of the species in that particular ecosystem. Studies regarding Gulf sturgeon behavior may be required to assist in development and design of fish passages. Modifications which provide for both up- and downstream travel by large and small fish need be considered.

First, an assessment of existing modifications should be conducted. The assessment should consider the effectiveness of the modification for use by other migratory species such as shad and striped bass. Designs should be solicited from engineering and environmental consultants. Passage structures which show promise must be evaluated to document the relative degree of usage by Gulf sturgeon. The NMFS, COE, NBS, FWS, and Federal Energy Regulatory Commission (FERC) should investigate the use of potential passage structures and initiate action or studies to assess the structure's effectiveness for Gulf sturgeon passage.

2.4.3 Operate and/or modify dams to restore the benefits of historical flow patterns and processes of sedimentation.

The operating schedules of the dams need to be evaluated to determine if water releases are benefiting the life history requirements of the Gulf sturgeon. The operations of existing structures found to be detrimental to the life cycle of Gulf sturgeon should be evaluated to determine if modifications to approximate historical flow and sedimentation patterns are possible. The COE and FERC in coordination with the GSMFC, Gulf states resource management agencies, FWS, and NMFS should identify potential modifications to and/or operations of dams and initiate action or studies to assess the feasibility for implementation.

2.4.4 Identify potential modifications to specific navigation projects to minimize impacts which alter riverine habitats or modify thermal or substrate characteristics of those habitats.

Navigation projects that have altered or modified the thermal characteristics or natural substrates of rivers should be evaluated to determine if modifications to approximate historical conditions are possible. The COE should assist the FWS in its efforts to define and protect Gulf sturgeon spawning and other essential habitats in federal project areas. The COE should study, seek funding, implement or take appropriate remedial actions to rectify navigation projects where feasible.

2.4.5 Restore the benefits of natural riverine habitats.

Dams and channel modifications have reduced habitat diversity within the range of the Gulf sturgeon. Diversity of riverine habitat (e.g., main channel, side channel, backwater and braided channel) promotes a corresponding faunal diversity. The Gulf sturgeon evolved in natural riverine settings where such diversity was prevalent. Gulf sturgeon survival could be expected to be compromised if the benefits of riverine habitat diversity are not restored. The FWS should work with the COE to identify ways to restore and protect natural river habitat diversity.

2.4.6 Seek optimum consistency between the purposes of federal and state authorized reservoirs, flood control projects, navigation projects, hydropower projects, and federal and state mandated restorations of fish populations.

Many water projects, such as hydropower and flood control dams and navigation activities, are authorized by state and federal governments for their respective purposes. Also, there are many state and federal programs authorized to restore declining fish populations. Examples include species listed under the ESA, anadromous fisheries addressed under the Anadromous Fish Conservation Act, and coastal fisheries addressed under the Interjurisdictional Fisheries Act and the Magnuson Fisheries Conservation and Management Act.

All government authorized and proposed projects and mandates should be reviewed in order to evaluate the potential to achieve recovery of Gulf sturgeon. The GSMFC should facilitate a multi-agency effort to identify project mandates and prepare a summary and recommendation report in partnership with the appropriate state and federal agencies. Recommendations should be forwarded to each of the States of Louisiana, Mississippi, Alabama, and Florida's State legislature and congressional delegation.

2.5 Maintain genetic integrity and diversity of wild and hatchery-reared stocks.

Major conservation issues that must be addressed by this recovery program relative to health of stocks, genetic conservation of stocks and displacement of stocks. A major concern in any stock restoration and enhancement program is the potential impact of introduced fish on existing wild stocks. This impact can affect wild stocks by a variety of mechanisms:

1. Disease and parasite transfer.
2. Behavioral and ecological interference.
3. Genetic consequences of interbreeding, reduction in gene flow, introduction of strains susceptible to disease.

Problems resulting from failure to protect habitat, to control fishing pressure, to ensure correct management of water resources, to control environmental contamination, and to effectively manage other parameters have contributed to reductions in stocks of Gulf sturgeon. These problems are readily evident and appropriate actions can be taken to correct them. At this point, the potential adverse effects of initiating a stocking program are unknown. The potential effects of initiating any stocking program should be evaluated. An experimental hatchery and strictly limited release program to the wild is prudent until such time as stocking has been thoroughly evaluated.

2.5.1 Evaluate the need to stock hatchery-produced Gulf sturgeon considering habitat suitability and current population status.

An assessment of whether stocking hatchery-produced fish will benefit the overall recovery of the Gulf sturgeon is paramount to the future development of Gulf sturgeon hatchery programs. An evaluation of whether the rivers to be stocked have suitable habitat to support the stocked fish, natural reproduction, and any progeny should be conducted. The recovery of the subspecies cannot be based on a "put and take" Gulf sturgeon fishery. Government agencies, NGOs, and universities investigating Gulf sturgeon should conduct an evaluation of each river system that is under consideration for stocking on the ability of the system, at its current status, to support the stocked fish and assure that natural reproduction can occur. Only ongoing improvements to the river systems should be included in the analyses. Each of the Gulf states resources management agencies should evaluate the river systems in their states. The FWS should take the lead in coordinating the assessment and preparing a summary finding report. No stocking should be conducted without approval by appropriate state agencies.

If it is determined that there is a need for stocking, the stocking should be secondary to other recovery efforts that identify essential habitats and emphasize habitat restoration. The COE should continue to work with the FWS in efforts to construct a permanent hatchery on the Apalachicola River to help in the restoration and maintenance of the Apalachicola River Gulf sturgeon population if it is determined that stocking is necessary for recovery of the subspecies.

2.5.2 Develop policy and guidelines for hatchery and culture operations related to stocking.

Raising hatchery produced fish to a size large enough to overcome lack of suitable habitat increases survival. Also, at larger sizes, these fish can be tagged and recovered, enabling assessment of the efficacy or success of the stocking effort. Peer review and evaluation of a particular stocking effort should be included in any proposal to release hatchery-reared Gulf sturgeon. Gulf states resource management agencies, GSMFC, FWS, NMFS, NGOs, universities, and other involved

researchers should prepare a hatchery and culture operations plan relating to stocking policy/guidelines. The FWS should take the lead in coordinating, seeking peer review, and completing the document.

2.5.3 Develop and implement a regulatory framework to eliminate accidental and intentional introductions of non-indigenous stock or other sturgeon species.

Release of hatchery-reared fish without a program of monitoring does not fulfill government's role as a steward of renewable natural resources. Monitoring and systematic assessment of stocks will assist in determining the impact of accidental and intentional releases of non-indigenous stock or other sturgeon species. This recovery plan recognizes that it is irresponsible to intentionally release fish without review or concurrence from the recovery team or coordinator, and therefore undocumented intentional releases should not occur. In the case of federal agencies who undertake actions that may affect a listed species (stock introductions), consultation with FWS and/or NMFS is required under section 7 of the ESA.

At a minimum, the recommendations of the Aquatic Nuisance Species Task Force (ANSTF) which was established under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 should be conducted. The task force developed recommendations regarding direct introductions and indirect, accidental release from public and private sector facilities. All State agencies within the subspecies' range and GSMFC, FWS, NBS, NMFS, NGOs, universities, and other involved researchers should prepare a consensus policy regarding introduction of non-indigenous sturgeon stocks into the range of Gulf sturgeon in accordance with the options or actions identified by the ANSTF to reduce risks and adverse consequences associated with introductions. States should implement necessary actions for promulgating regulations consistent with the policy.

3.0 Coordinate and facilitate exchange of information on Gulf sturgeon conservation and recovery activities.

Any research and/or management activities on fish species which transcend jurisdictional boundaries must be coordinated. Management and recovery actions must be consistent across the range of the subspecies in order to be effective. Gulf sturgeon recovery efforts will be enhanced by the coordination of activities and exchange of information regarding the biology and management of all sturgeon species.

3.1 Coordinate research and recovery actions.

Coordination activities involving state and federal resource management agencies, NGOs, and universities with an interest in the Gulf sturgeon should be conducted at least every two years. Such coordination will provide for studies and management plans which will reduce

duplication of effort, enhance cooperation, and optimize agency manpower and funding. The FWS and GSMFC should take the lead in conducting the coordination activities.

3.2 Develop an effective communication program or network for obtaining and disseminating information on recovery actions and research results.

All recovery participants including state and federal agencies, NGOs, and universities working on Gulf sturgeon are strongly urged to publish research findings in technical publications. Unpublished reports (gray literature), bibliographies, and available data on Gulf sturgeon should be compiled and published or otherwise made available to all participants. Acquiring, disseminating, and maintaining information regarding Gulf sturgeon recovery activities should be centralized. The FWS should take the lead in collecting and centralizing information regarding Gulf sturgeon recovery activities.

In order to ensure effective communication among the various entities involved in Gulf sturgeon research, recovery and management, a newsletter should be developed and disseminated on a regular basis. This newsletter would provide all interested parties with the most up-to-date information regarding progress toward achieving the goals of the Recovery Plan. The FWS should take the lead in preparing, printing, and disseminating the newsletter and coordinating with other existing sturgeon newsletters.

3.3 Develop a non-scientific constituency and public information program directed toward enhancing recovery actions.

In order for Gulf sturgeon recovery actions to be successful, the general public must be aware of such actions and understand the need for them. An information and education program must be developed to inform the public of the causes of the decline of Gulf sturgeon, to increase the public's awareness, understanding, and involvement in Gulf sturgeon recovery efforts and to promote wise use of land in watersheds. Educational materials such as brochures, newspaper and magazine articles, publications, posters, and slide and television presentations, among others, must be produced and disseminated to target audiences, such as commercial and recreational fishermen, boaters, and civic organizations. The Gulf states resource management agencies, FWS, NBS, and NMFS should seek funding for the development of educational material for dissemination to the public. The FWS or GSMFC should take the lead in coordinating this effort providing a centralized location for storage of information if necessary.

4.0 Implement recovery program.

Existing budgets of involved agencies and other parties are not capable of fully funding the Gulf sturgeon recovery plan. Competition for funding under the ESA is intense, partly due to the low level of appropriations to the program and the increasing number of listed species. In order to assure that actions which would result in recovery of the Gulf sturgeon are implemented, funding

for activities must be secured and a designated lead recovery office must be identified. Involvement of NGOs, and universities should be solicited.

4.1 Designate and fund a Gulf sturgeon recovery lead office.

Funding to support a FWS recovery lead office must be identified to coordinate a multi-agency, multi-disciplinary recovery implementation committee. The lead office should document all research, recovery, and management information and plans. Work would be combined with other FWS duties. The lead office should be in a location which facilitates coordination with all Gulf sturgeon activities. The lead office should be funded until the Gulf sturgeon is considered recovered according to the Recovery Plan.

4.2 Seek funding for Gulf sturgeon recovery activities.

The recovery lead office, with support from involved agencies, NGOs, universities, and the public should seek to bring high visibility to the need for funding of Gulf sturgeon recovery activities. Funding strategies to acquire Congressional appropriations and other funding sources should be developed. The recovery lead office should facilitate this effort and coordinate a unified funding package for Gulf sturgeon recovery activities in the southeast.

4.3 Implement projects or actions which will achieve recovery plan objectives.

Based on the recovery plan, a series of specific projects will be identified which could bring about improvements in the habitat or stock condition of Gulf sturgeon in specific river systems throughout the range of the species. Projects should be submitted to the appropriate agencies or funding sources for consideration. The Gulf states resource management agencies should be given first opportunity to implement the identified projects, through joint efforts with FWS, NBS, NMFS, universities, NGOs, or other interested researchers.

4.4 Develop and implement a program to monitor population levels and habitat conditions of known populations in the management units as well as newly discovered, introduced, or expanding populations.

The status of the subspecies and its ecosystems should be monitored to assess any progress toward recovery while recovery actions are ongoing and following completion of actions. A standardized assessment program should be designed by a multi-agency group coordinated by the recovery lead office and the GSMFC. The Gulf states resource management agencies, federal agencies, universities, NGOs, and other researchers should conduct an annual assessment of the management unit population levels in their area of responsibility or as appropriate. The recovery lead office should maintain, collate, and review the assessments preferably on an annual basis but at least every two years. This information should be summarized for distribution and used in the Congressionally required biennial species status reports.

5.0 Monitor recovery program.

A recovery plan benefits a species only if it is implemented. The plan and its implementation must be strong enough to provide adequate guidance to species managers but be flexible enough so that it may be changed or revised to recover the species. In addition, the FWS and NMFS are required by Congress to track the status of all listed species and the implementation of recovery plans, financial expenditures for each species or clusters of species, and status of recovered species.

5.1 Assess overall success of the recovery program and recommend action.

The recovery program must be evaluated periodically to determine if it is making progress in achieving recovery objectives and to recommend future actions. These actions could include changes in recovery objectives, continuing or increasing protection, implementing new measures, revising recovery plans and recommending delisting. The recovery program should be preferably evaluated annually but at least biennially. The recovery lead office should be responsible for collection of the required information and preparation of the Congressional reports. As part of this effort, the lead office should prepare standardized reporting forms so that the affected parties can easily provide the necessary information. Reporting requirements should continue for five years after the delisting of the Gulf sturgeon.

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III. IMPLEMENTATION SCHEDULE

The Implementation Schedule indicates task priorities, task numbers, task descriptions, duration of tasks, potential or participating parties, and lastly, estimated costs (Table 3). These tasks, when accomplished, will bring about the recovery objectives for the Gulf sturgeon as discussed in Part II of this plan.

Parties with authority, responsibility, or expressed interest to implement a specific recovery task are identified in the Implementation Schedule. When more than one party has been identified, the proposed lead party is indicated by an asterisk (*). The listing of a party in the Implementation Schedule does not imply a requirement or that prior approval has been given by that party to participate or expend funds. However, parties willing to participate will benefit by being able to show in their own budget submittals that their funding request is for a recovery task which has been identified in an approved recovery plan and is therefore part of the overall coordinated effort to recover the Gulf sturgeon. Also, Section 7(a)(1) of the ESA directs all federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of threatened and endangered species.

Following are definitions to column headings and keys to abbreviations and acronyms used in the Implementation Schedule:

Task Number & Task: Recovery tasks as numbered in the recovery outline. Refer to the Narrative for task descriptions.

Priority Number: All priority 1 tasks are listed first, followed by priority 2 and priority 3 tasks.

Priority 1 - All actions that must be taken to prevent extinction or to prevent the subspecies from declining irreversibly in the foreseeable future.

Priority 2 - All actions that must be taken to prevent a significant decline in subspecies population/habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery (or reclassification) of the species.

Task Duration: Years to complete the corresponding task. Study designs can incorporate more than one task, which can reduce the time needed for task completion.

Underway - Task already being implemented.

Continuing - Task necessary until recovery.

Responsible or Participating Party: Federal or state government agencies or universities (party) with the responsibility and/or capability to fund or carry out the corresponding recovery task.

FWS Region - FWS Regions (only states in the Gulf sturgeons's range are listed)
- 2 - Albuquerque (Texas)
- 4 - Atlanta (LA, MS, AL, FL)

FWS Program - Division or program of the FWS
- FF- Fisheries
- FRO- Fisheries Resources Office
- ES- Ecological Services
- LE- Law Enforcement
- WNFH- Welaka National Fish Hatchery
- WSRFC- Warm Springs Regional Fisheries Center
- GCFCO- Gulf Coast Fisheries Coordination Office

Other Federal Agencies
- COE - U.S. Army Corps of Engineers
- EPA - U.S. Environmental Protection Agency
- MMS - Minerals Management Service
- NMFS - National Marine Fisheries Service
- FERC - Federal Energy Regulatory Coummission
- NBS - National Biological Service/Southestern Biological Science Center Gainesville, FL
- NRCS - Natural Resources Conservation Service

State Agencies
- GSRMA - Gulf States Resource Management Agencies
  - Louisiana Department of Wildlife and Fisheries
  - Mississippi Department of Wildlife, Fisheries, and Parks
  - Alabama Department of Conservation and Natural Resources
  - Florida Department of Environmental Protection
  - Texas Parks and Wildlife Department
- CES - Cooperative Extension Service (all GSRMA)

Other Parties
- GSMFC - Gulf States Marine Fisheries Commission
- CCC - Caribbean Conservation Corporation
- UF - University of Florida

Cost Estimates: Estimated fiscal year cost, in thousands of dollars, to complete the corresponding task. The costs associated with a task or party represent the estimated dollar amount to complete the task and are not necessarily the fiscal responsibility of the associated party.

Study designs can incorporate more than one task, which when combined can reduce the cost from when tasks are conducted separately. Cost for implementing "continuing" recovery tasks are in excess of what is displayed for the five years in the schedule.

Comments: Additional information if appropriate.

TABLE 3. IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

Priority	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
1	1.3.1	Develop and implement standardized population sampling and monitoring techniques	underway	4	FF* FRO-PC	NBS* GSRMA COE	1 6	30 20 2	1 20	30 20 2	7 40	30 32 5	1 40	30 32 5	1 40	30 32 5	Tasks 1.1.1, 1.3.1, 2.5.1, and 1.5.1 can be conducted concurrently
1	2.5.3	Develop and implement a regulatory framework to eliminate acidental and intentional introductions of non-indigenous stock or other sturgeon species	1	4	FF FRO-PC* ES-PC GCFCO	NBS* GSRMA GSMFC UF			5 8 2 2	2 4 1 1							Some of this effort will be dependent on the outcome of 2.5.1
1	2.1.2	Reduce or eliminate incidental mortality	underway continuing	4	FRO-PC* ES	GSMFC* GSRMA NMFS	15	15 20 75	15	15 20 75	15	15 20 75		75		25	Majority of funding for fish excluder devices & sampling protocols
1	2.4.5	Restore the benefits of natural riverine habitats	underway continuing	4	ES FRO-PC GCFCO	NBS COE GSRMA	2 2 2	2 10 8	10 2 2	2 20 12	10 2 2	2 20 12	20 5 3	3			Wk funded under existing programs. Actual restoration costs undetermined.
1	2.3.1	Utilize existing authorities to protect habitat and where inadequate, recommend new incentives, laws, and regulations	underway continuing	4	ES* GCFCO	EPA* COE GSRMA GSMFC	5 3	5 5 8 3	5 3	5 5 8 3	5 3	5 5 8 3	5 3	5 5 8 3			Section 7 consultation conducted with existing program funds
2	2.1.1	Increase effectiveness and enforcement of state and federal take prohibitions	continuing	4	LE FF* ES*	NMFS* GSRMA*	75	75 180	75	75 180	75	75 180	75	75 180	75	75 180	Sec 7 consultation will be conducted under existing programs. Addt. monitoring or law personnel may be necessary
2	1.1.1	Conduct and refine field investigations to locate important spawning, feeding, and developmental habitats	underway continuing	4	FF FRO-PC* GCFCO	NBS* GSRMA COE CCC UF	1 5 1	20 60 5 10 1	1 58 1	20 60 5 10 1	1 70 2	20 80 5 10 2	1 70 2	20 80 5 12 2	1 70 5	20 80 5 12 5	Tasks 1.1.1, 1.3.1, 2.5.1, and 1.5.1 can be conducted concurrently

TABLE 3. (continued). IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

PRIORITY	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
2	1.1.2	Characterize riverine, estuarine, and neritic areas that provide essential habitat	underway continuing	4	FRO-PC*	NBS* CCC GSRMA COE	5	15 2 28 5	20	15 2 28 5	70	15 3 40 5	70	15 3 40 5	10	15 3 40 5	Tasks 1.1.1 and 1.1.2 can be conducted concurrently
2	1.2	Conduct life history studies on the biological and ecological requirements of little known or inadequately sampled life stages	underway continuing	4	FRO-PC*	NBS* CCC GSRMA	5	25 2 28	20	25 2 28	20	25 3 40	40	25 3 40	40	25 3 40	Tasks 1.1.1 and 1.1.2, and 1.2 can be conducted concurrently
2	2.2.1	Identify potentially harmful chemical contaminants and water quality and quantity changes associated with surface water restrictions	3	4	ES-PC*	EPA GSRMA	25	10 40	15	10 100	75						Cost and time to complete year 2 efforts will be dependent on information collection in year 1.
2	2.2.2	Identify and eliminate potentially harmful point and non-point sources of chemical contaminants	4	4	ES-PC	EPA* GSRMA NRCS			20	10 28	25	15 40	25		25		
2	2.4.6	Seek optimum consistency between the purposes of federal and state authorized reservoirs, flood control, navigation, and hydropower projects and federal and state mandated restorations of fish populations	continuing	4	ES GCFCO	GSMFC* FERC COE NMFS				10		5		5		5	Most agency related wk., funded under existing programs

TABLE 3. (continued). IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

PRIORITY	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
2	2.4.1	Identify dam and lock sites that offer the greatest feasibility for successful restoration of and to essential habitats	1	4	ES-PC FRO-PC	GSMFC* COE GSRMA			5 2	15 10 20							
2	2.4.4	Identify potential modifications to specific navigation projects to minimize impacts which alter riverine habitats or modify thermal or substrate characteristics of those habitats.	underway continuing	4	ES FRO-PC GCFCO	FERC* COE* NMFS GSRMA GSMFC	5 5 5	10 10 2 8 5	5 5 5	10 10 2 8 5	2 2 2	5 5 2 4 2					Some funding under existing programs. Proj. mod. costs undetermined and may require Congress. author. & non-federal sponsor
2	4.3	Implement projects or actions which will achieve recovery plan objectives	underway continuing	4	FF FRO-PC	GSRMA* NGOs											Individual project funding ID elsewhere in schedule
2	4.2	Seek funding for Gulf sturgeon recovery activities	underway continuing	4	ES* GCFCO	NBS GSMFC GSRMA											Funded under existing programs
2	2.2.4	Identify and eliminate known and potential impacts to water quantity and quality associated with existing and proposed developments, agricultural uses, and water diversions in management units	continuing	4	ES	NBS EPA* GSRMA NRCS	2	2 2 8	10	5 20 8	75	5 20 8	75	5 20	75	20	Amount of effort will be determined by outcome of task 2.2.1
2	2.2.5	Assess the relationship between groundwater pumping and reduction of groundwater flows into management units, and quantify loss of riverine habitat related to reduced groundwater in-flows	2	4	ES	USGS* GADNR						252		125			Mostly funded under the Tri-state Comp Study- AL,GA,FL

TABLE 3. (continued). IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

PRIORITY	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
3	2.5.1	Evaluate the need to stock hatchery-produced Gulf sturgeon considering habitat suitablity and current population status	underway	4	FF FRO-PC ES-PC GCFCO	NBS GSRMA	1 1 1 1	5 8	1 3 1 1	10 8	1 5 2 1	10 4	1 10 2 1	10 4	1 10 2 1	10 13	Tasks 1.1.1, 1.3.1, 2.8.1, and 1.5.1 can be conducted concurrently
3	1.5.1	Conduct a Gulfwide genetic assessment to determine geographically distinct management units	underway	4	FF* FRO-PC GCFCO	NBS GSRMA NGOs	15 8 2	1 3 1	15 48 1	1 100 1							Majority of samples and analyses completed 1995. Will continue to completion.
3	2.2.3	Assess selected contaminant levels in Gulf sturgeon from management units	underway continuing	4	FF* ES*	EPA* GSRMA	15		30	10 20	30	10 20	10	5 20			Study on adult fish across FL panhandle completed 1994. Study on juvenile fish, Suwannee River completed 1995.
3	1.3.2	Develop population models	underway continuing	4	FF FRO-PC	NBS NMFS GSRMA NGOs	5 15	15 2 8 2	5 5	15 2 8 2	20				-		
3	4.1	Designate and fund a Gulf sturgeon recovery lead office	continuing	4	ES* FF		7 3		7 3		7 3		7 3		7 3	7 3	Majority of funding provided under other recovery actions
3	1.4.1	Continue culture of Gulf sturgeon	underway	4	WNFH WSRFC* FRO-PC	NBS LDWF ADNCR UF	3 2 1	2 3 3 5	23 25 10	2 3 3 5	23 25 10	2 5 5 5	23 25 10	2 5 5 10	23 25 10	2 5 5 10	

TABLE 3. (continued). IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

PRIORITY	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
3	2.2.6	Conduct studies to determine the effects of known chemical contaminants in water from management units on Gulf sturgeon or a surrogate species	4	4	ES-PC* WNFH WSRFC	EPA NBS			75 5	10 5	75 5	10 5	75		75		WNFH & NBS may provide specimens for the studies
3	2.4.3	Operate and/or modify dams to restore the benefits of historical flow patterns and processes of sedimentation	underway continuing	4	ES FRO-PC GCFCO	FERC* COE* NMFS GSMFC											Some funding under existing programs. Project mod. costs undeterm. May require Congress. authority & non-federal sponsor.
3	2.3.2	Identify, protect, and/or acquire appropriate land or aquatic habitats on an ecosystem approach	underway continuing	4	FF FRO-PC ES-PC* GCFCO RW	NBS NMFS GSRMA NGOs											ID conducted with other studies. Land acquis. & water rights costs undeterminable.
3	2.4.2	Evaluate, design, and provide means for Gulf sturgeon to bypass migration restrictions to essential habitats	continuing	4	ES FF	FERC* COE* NMFS				10 10		25 25		25 25		25 25	FWS & NMFS funded under exist. progs. Studies conducted or infrastructure funded by COE & FERC. May req. Congress. auth. & non-fed sponsor.
3	3.1	Coordinate research and recovery actions	continuing	4	ES* FF GCFCO	NBS GSMFC*	5	5	10 5 5	2 15	5	5	10 5 5	2 15	5	5	Funding for biennial workshops
3	2.5.2	Develop policy and guidelines for hatchery and culture operations related to stocking	2	4	FF FRO-PC* ES-PC GCFCO	NBS* GSRMA GSMFC UF			5 5 2 2	2 4 1 1					5 10 5 5	2 4 2 15	Conducting this effort will be dependent on the outcome of 2.5.1
3	3.2	Develop an effective communication program or network to obtain and disseminate information on recovery actions and research results	continuing	4	ES*	GSMFC CES			5	5 2	5	5 2	5	5 2	5	5 2	Funding for producing and distributing quarterly newsletters

TABLE 3. (continued). IMPLEMENTATION SCHEDULE FOR GULF STURGEON RECOVERY ACTIONS

GULF STURGEON RECOVERY IMPLEMENTATION SCHEDULE

PRIORITY	TASK #	TASK DESCRIPTION	TASK DURATION (YEARS)	RESPONSIBLE PARTY			ESTIMATED FISCAL YEAR COSTS ($000)										COMMENTS
				FWS		OTHER	FY 1		FY 2		FY 3		FY 4		FY 5		
				Region	Program		FWS	Other	FWS	Other	FWS	Other	FWS	Other	FWS	Other	
3	3.3	Develop a non-scientific constituency and public information program directed toward enhancing recovery actions	underway continuing	4	FF* ES* GCFCO CES	GSMFC* NMFS GSRMA			5 5 8	10 5	5 5 8	10 5	5 5 8	5	2 2 8	5	
3	1.5.2	Assess the potential to develop genetic markers to differentiate wild and hatchery-produced Gulf sturgeon	ongoing	4	FF* ES	NMFS UF			25 25	10 10	25 25	10 10					Funding this task dependent on task 1.4.3 decision
3	1.4.2	Identify physical, chemical and biological parameters necessary to maintain growth, health, and survival of fish reared under artificial conditions	underway continuing	4	WNFH WSRFC*	NBS UF LDWF ADNCR	5 5	10 5 3 3	5 20	10 5 3 3	10 20	10 8 5 5	10 20	10 8 5 5	10 20	10 10 5 5	Continuation of this effort dependent on the outcome of 2.8.1.
3	1.4.3	ID and test non-genetic internal and external markers or techniques to differentiate wild and hatchery-produced Gulf sturgeon	2	4	FF FRO-PC*	NBS CCC GSRMA			25 5	5 2 4	25 5	5 2 4					Funding this task dependent on task 1.4.3 decision
3	4.4	Develop and implement a program to monitor levels and habitat conditions of known populations in the management units as well as newly discovered, introduced, or expanding populations	continuing	4	ES* FRO-PC	NBS CCC GSRMA	1 5	5 5 20	5 5	5 5 20	1 5	5 5 20	5 5	5 5 20	1 5	5 5 20	
3	5.1	Assess overall success of the recovery program and recommend action	continuing	4	ES*		2		2		2		2		2		

APPENDIX A

FISHERY MANAGEMENT JURISDICTIONS, LAWS AND POLICIES AFFECTING THE GULF STURGEON

APPENDIX A

FISHERY MANAGEMENT JURISDICTIONS, LAWS AND POLICIES AFFECTING THE STOCKS:

Gulf sturgeon may utilize both fresh water and marine habitats at different times of the year. Excursions into the territorial waters (Exclusive Economic Zone) of the United States may occur. This factor in its biology, together with its range, subject the subspecies to the regulatory jurisdictions of the federal government as well as the States of Alabama, Louisiana, Mississippi and Florida. Numerous state and federal legislative and regulatory actions may affect the stocks. The following is a partial list of some of the more important agencies and regulations that affect the Gulf sturgeon and its habitat. State agencies should be consulted for specific and current state laws and regulations.

Federal Management Institutions. Although some recreational and subsistence harvests of Gulf sturgeon have occurred at times, the primary fishery for the sturgeon has been commercial. Because Gulf sturgeon fisheries have occurred primarily in state waters, federal agencies historically have not directly managed the stocks; though, the federal government has maintained commercial fishery landing records on the subspecies for about the past 100 years. Nonetheless, a variety of federal agencies, through their administration of laws, regulations and policies, may influence Gulf sturgeon stocks.

Regional Fishery Management Councils. With the passage of the Magnuson Fishery Conservation and Management Act (MFCMA), the federal government assumed responsibility for fishery management within the Exclusive Economic Zone (EEZ). The EEZ is contiguous to the territorial sea, with an inner boundary at the outer boundary of each coastal state. The outer boundary continues out 200 miles. Management of the EEZ is to be based on fishery management plans developed by regional fishery management councils. Each council prepares plans, with respect to each fishery requiring management, within its geographical area of authority and amends such plans as necessary. Plans are implemented as federal regulation through the Department of Commerce (DOC).

Among the guidelines, under which the councils must operate, are standards which state that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range and that management shall, where practicable, promote efficiency, minimize costs and avoid unnecessary duplication (MFCMA Section 301a).

The Gulf of Mexico Fishery Management Council has not developed, nor is it considering, a management plan for the Gulf sturgeon. Furthermore, no significant fishery for the subspecies exists in the EEZ of the U.S. Gulf of Mexico.

Department of Commerce, National Oceanic and Atmospheric Administration (NOAA).

National Marine Fisheries Service. The Secretary of Commerce, acting through the NMFS, has the ultimate authority to approve or disapprove all fishery management plans prepared by regional fishery management councils. Where a council fails to develop a plan, or to correct an unacceptable plan, the Secretary may do so. The NMFS also collects data and statistics on fisheries and fishermen, performs research, and conducts management authorized by international treaties. The NMFS has the authority to enforce the Magnuson Act and the Lacey Act and is the federal trustee for living and nonliving natural resources in coastal and marine areas under United States jurisdiction pursuant to the Endangered Species Act, Section 107(f) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund"), Section 311(f)(5) of the Clean Water Act (CWA), Executive Order 12580 of January 23, 1987, and Subpart G of the National Oil and Hazardous Substances Pollution Contingency Plan.

The NMFS exercises no management jurisdiction of the Gulf sturgeon, other than permitting scientific or incidental take under the Endangered Species Act and enforcement. The NMFS conducts some research and data collection programs and comments on all projects that affect marine fishery habitat under the Fish and Wildlife Coordination Act and Section 10 of the Rivers and Harbors Act.

The NMFS has entered into a Cooperative Agrrement with the Department of the Army to Restore and Create Fish Habitat. Under this agreement, the NMFS and the COE coordinate efforts to identify federal projects that could be modified to enhance fish habitat.

Office of Ocean and Coastal Resource Management (OCRM). The OCRM asserts its authority through the National Marine Sanctuaries Program pursuant to Title III of the Marine Protection, Research, and Sanctuaries Act (MPRSA). The OCRM Estuarine Sanctuary Program has designated Looe Key in Monroe County, Rookery Bay in Collier County, the Apalachicola River and Bay in Franklin County, Florida, and Weeks Bay in Baldwin County, Alabama, as estuarine sanctuaries.

The OCRM may influence fishery management for Gulf sturgeon indirectly through administration of the Coastal Zone Management Program and by setting standards and approving funding for state coastal zone management programs. Some states in the Gulf utilize a portion of these monies in their habitat protection and enhancement programs including reef maintenance and enhancement.

Department of the Interior (DOI).

National Park Service (NPS). The NPS under the DOI may regulate fishing activities within national park boundaries. Such regulations may affect Gulf sturgeon within specific parks. The NPS has authority to protect fishes and fish habitat primarily through

the establishment of coastal and nearshore national parks and national monuments. Everglades National Park in Florida and the Mississippi District of Gulf Islands National Seashore are two examples of national park areas where Gulf sturgeon may occur.

U.S. Fish and Wildlife Service. The authority of the FWS to affect the management of the Gulf sturgeon is based primarily on the Endangered Species Act and the Fish and Wildlife Coordination Act. The FWS is the lead agency in developing the recovery plan for the subspecies under the Endangered Species Act. Under the Fish and Wildlife Coordination Act, the FWS, in conjunction with the NMFS, reviews and comments on proposals to alter habitat. Dam construction, drainage projects, channel alteration, wetlands filling and marine construction are projects that can potentially affect the Gulf sturgeon. Further, the FWS may seek mitigation of fishery resource impairment due to federal water-related development. The FWS has the responsibility to focus efforts on nationally significant fishery resources. The FWS also facilitates restoration by rebuilding certain major, economically valuable, anadromous, endangered, threatened, and interjurisdictional (managed by two or more states) fishery resources to full, self-sustainable productivity. Because the Gulf sturgeon is a threatened and an anadromous species, the FWS has conducted studies on various aspects of the subspecies' biology.

Gulf sturgeon occur in the aquatic portions (riverine, estuarine, marine) of national wildlife refuges (NWR) such as Pine Island NWR, Island Bay NWR, Passage Key NWR, Pinellas NWR, Chassahowitzka NWR,Cedar Keys NWR, Lower Suwannee NWR, St. Marks NWR, St. Vincent NWR, Florida, Bon Secour NWR, Alabama, Bogue Chitto NWR, Louisiana and Mississippi, and Delta NWR, Breton Island NWR, Bayou Sauvage NWR, Lacassine NWR, Louisiana. Fish and wildlife populations and their harvest within refuges are usually managed by the respective state which the refuge is located. Special use permits are required for commercial fishing on national wildlife refuges.

National Biological Service. The National Biological Service (NBS) is the Department of Interior's newest bureau. The NBS was created November 11, 1993, by consolidating the biological research, inventory, monitoring, and information transfer programs of seven Interior bureaus: FWS, NPS, MMS, USGS, Bureau of Land Management, Bureau of Reclaimation, and Office of Surface Mining. The Southeastern Biological Service Center (Center), Gainesville, Florida, of NBS was formerly a research center for FWS. The Center has conducted research on Gulf sturgeon since 1987 and will continue work in this area as requested by FWS and other agencies.

Environmental Protection Agency. The EPA, through its administration of the Clean Water Act, National Pollutant Discharge Elimination System (NPDES), may provide protection to Gulf sturgeon habitat. Applications for permits to discharge pollutants may be disapproved or conditioned to protect fresh and estuarine aquatic resources.

U.S. Department of the Army, Corps of Engineers. Gulf sturgeon habitat may be influenced by the COE's regulatory responsibilities pursuant to the Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. Under these laws, the COE may authorize proposals to dredge, fill and construct in navigable waters (Section 10) or to discharge dredged or fill material into wetland areas and waters of the United States (Section 404). Such proposals could affect Gulf sturgeon habitat. The COE is also responsible for planning, construction and maintenance of dams, navigation channels and other projects that may affect Gulf sturgeon habitat.

Treaties and Other International Agreements. There are no treaties or other international agreements that affect the Gulf sturgeon. No foreign fishing applications for Gulf sturgeon harvest have been submitted to the United States government.

Federal Laws, Regulations and Policies. The following Federal laws, regulations and policies may directly and indirectly influence the habitat, populations and ultimately the management of the Gulf sturgeon.

Anadromous Fish Conservation Act (AFCA). The AFCA authorizes the Secretary of the Interior to initiate cooperative programs with the states to conserve, develop and enhance the nation's anadromous fisheries. The Act authorizes construction, installation, maintenance and operation of structures to improve or facilitate feeding, spawning and free migration of anadromous fish.

Coastal Zone Management Act and Estuarine Areas Act. Congress passed policy on values of estuaries and coastal areas through these Acts. Comprehensive planning programs to be carried out at the state level, were established to enhance, protect, and utilize coastal resources. Federal activities must comply with the individual state programs. Habitat may be protected by planning and regulating development damage to sensitive coastal habitats.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). This act is also referred to as the "Superfund". It can provide funding for "clean-up" of important habitat areas affected by oil spills or other distinct pollution discharge events.

Endangered Species Act (ESA). The ESA provides for the protection of habitat necessary for the continued existence of species listed as threatened or endangered. Section 7 of the ESA requires consultation with the FWS or NMFS by a federal agency if an action authorized, funded or carried out by such agency may affect a listed species or its critical habitat (a legal, area-specific designation). Section 7 also prohibits any federal action that would jeopardize the continued existence of a listed species or its critical habitat. Section 9 of the ESA prohibits any person or entity from "taking" a listed species without a proper permit from the FWS or NMFS. Under the ESA, taking may include harassment or habitat degradation if such would interfere with feeding, reproduction or

other essential life functions. The ESA also requires preparation of a recovery plan for each listed species outlining actions needed to allow the particular species to reach a population level at which it may be delisted.

Federal Power Act (FPA). The FPA regulates the construction and operation of hydroelectric power plants through a system of licenses and permits issued by the federal Energy Regulatory Commission (FERC) (formerly Federal Power Commission). The FWS, NMFS, state agencies and others may review proposed licenses and make recommendations with respect to the needs of instream flow for fish and wildlife downstream of dams as well as the impacts that reservoir establishment may have on fish and wildlife upstream of the dams. The Act also provides for construction of fish passage facilities during dam or diversion construction. Dams are likely major factors affecting anadromous fish populations in some Gulf streams.

Federal Water Pollution Control Act (FWPCA). Also called the "Clean Water Act", the FWPCA provides for the protection of water quality at the federal level. The law also provides for assessment of injury, destruction, or loss of natural resources caused by discharge of pollutants.

Of major significance is Section 404 of the Clean Water Act (CWA), which prohibits the discharge of dredged or fill material into navigable waters without a permit. Navigable waters are defined under the CWA to include all waters of the United States, including the territorial seas and wetlands adjacent to such waters. The permit program is administered by the COE. The Environmental Protection Agency (EPA) may approve delegation of Section 404 permit authority for certain waters (not including traditional navigable waters) to a state agency; however, it retains the authority to prohibit or deny a proposed discharge under Section 404(c) of the CWA. Recent attempts to revise Section 404 or change the legal definition of wetlands may affect the utility of the CWA in wetlands protection. Although of limited applicability to anadromous fish restoration, Section 404 may be important in protecting certain types of coastal habitats or in protecting water quality in certain streams. It may also be a consideration in approval of certain types of restoration projects.

The FWPCA also authorized programs to remove or limit the entry of various types of pollutants into the nation's waters. A point source permit system was established by the EPA and is now being administered at the state level in most states. This system, referred to as the National Pollutant Discharge Elimination System (NPDES), sets specific limits on discharge of various types of pollutants from point source outfalls. A non-point source control program focuses primarily on the reduction of agricultural siltation and chemical pollution resulting from rain runoff into the nation's streams. This control effort currently relies on the use of land management practices to reduce surface runoff through programs administered primarily by the Department of Agriculture.

Both chemical contamination and siltation may be major factors limiting populations of anadromous Gulf fish species. Efforts to achieve anadromous fish restoration in key river drainages should be aimed at assuring compliance with established point and non-point source reduction programs in these basins.

Federal Water Project Recreation Act. This Act requires that consideration be given to fish and wildlife enhancement in federal water projects.

Fish and Wildlife Act of 1956. This act provides assistance to states in the form of law enforcement training and cooperative law enforcement agreements. It also allows for disposal of property abandoned or forfeited in conjunction with convictions. Some equipment may be transferred to states. The act prohibits airborne hunting and fishing activities.

Fish and Wildlife Coordination Act (FWCA). The Fish and Wildlife Coordination Act (FWCA) is the primary law providing for consideration of fish and wildlife habitat values in conjunction with federal water development activities. Under this law the Secretaries of Interior and Commerce may investigate, report and advise on the effects federal water development projects may have on fish and wildlife habitat. Such reports and recommendations, which require concurrence of the state(s) involved, must accompany the construction agency's request for congressional authorization, although, the construction agency is not bound by the recommendations. Construction agencies may transfer funds to the FWS or NMFS to investigate and report on specific projects.

The FWCA also applies to water-related activities proposed by other organizations or individuals if those activities require a federal permit or license. The FWS and NMFS may review the proposed permit action and recommend to the permitting agencies to avoid or mitigate any potential adverse effects on fish and wildlife habitat.

Fish Restoration and Management Projects Act of 1950. Under this act, the DOI is authorized to provide funds to state fish and game agencies for fish restoration and management projects. Funds for protection of threatened fish communities that are located within state waters could be made available under the act.

Food and Agriculture Act of 1962. This Act established a Resource Conservation and Development Program for regionally-sponsored flood control and drainage projects that receive financial and technical assistance from the Soil Conservation Service. Though not as active a program as it once was, activities under this program may have relevance, both positive and negative, to anadromous fish habitat protection, restoration or enhancement.

Lacey Act of 1981, as amended. The Lacey Act prohibits import, export and interstate transport of illegally-taken fish and wildlife. As such, the Act provides for federal prosecution for violations of state fish and wildlife laws. The potential for federal

convictions under this Act, with its more stringent penalties, has probably reduced interstate transport of illegally-possessed Gulf sturgeon.

Magnuson Fishery Conservation and Management Act. This Act provides for the conservation of habitats throughout the ranges of anadromous species within the Exclusive Economic Zone (EEZ). It mandates the preparation of fishery management plans for important fishery resources and sets national standards to be met by such plans. Each plan attempts to define, establish and maintain the optimum yield for a given fishery.

Marine Plastic Research and Control Act of 1987 and MARPOL Annex V. MARPOL Annex V is a product of the International Convention for the Prevention of Pollution from Ships, 1973/78. Regulations under this Act prohibit ocean discharge of plastics from ships; restrict discharge of other types of floating ship's garbage (packaging and dunnage) for up to 25 nautical miles from any land; restrict discharge of victual and other recomposable waste up to 12 nautical miles from land; and require ports and terminals to provide garbage reception facilities. The MPRCA of 1987 and 33 CFR, Part 151, Subpart A, implement MARPOL V in the United States.

Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), Titles I and III and the Shore Protection Act of 1988 (SPA). The MPRSA protects fish habitat through establishment and maintenance of marine sanctuaries. This Act and the SPA regulate ocean transportation and dumping of dredged materials, sewage sludge and other materials. Criteria for issuing permits include considering the effects dumping has on the marine environment, ecological systems and fisheries resources. Permits are issued by the Corps of Engineers.

National Environmental Policy Act (NEPA). The NEPA requires an environmental review process of all federal actions. This includes preparation of an environmental impact statement for major federal actions that may affect the quality of the human environment. Less rigorous environmental assessments are reviewed for most other actions while some actions are categorically excluded from formal review. These reviews provide an opportunity for the agency and the public to comment, on projects that may impact fish and wildlife habitat.

Oil Pollution Act. This Act provides a degree of protection to coastal fisheries habitat by regulating discharge of oil from United States registry ships. Under the Act, tankers cannot discharge oil within 50 nautical miles of land, and other ships must discharge as far as practicable from land.

Outer Continental Shelf (OCS) Lands Act Amendments of 1979. These Amendments provide for assessments of the effects oil and gas exploration, development and production have on biological resources. The law also provides a channel for comments on federal approval of leasing OCS areas for exploration and development. Oil and gas

leasing activities could be of concern for coastal anadromous fish habitat and offshore winter habitat of the Gulf sturgeon.

River and Harbor Act of 1899. Section 10 of the River and Harbor Act requires a permit from the U.S. Army Corps of Engineers (COE) to place structures in navigable waters of the United States or modify a navigable stream by excavation or filling activities.

Water Resources Development Acts (WRDA). These legislative actions authorize the COE to study and/or construct individual water resource projects. Prior to 1974 such acts were known as the "Flood Control Act of (year)", the "River and Harbor Act of (year)" or commonly called the "Omnibus Bill." Beginning in 1974 these laws have been referred to as the "WRDA of (year)". Numerous projects may be authorized under these Acts in any given year. Under the FWCA, "Wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs . . ." and the FWS, NMFS and state fish and wildlife agencies may review, comment and make recommendations to the COE regarding these projects' impacts on fish and wildlife resources. These comments may address the avoidance, mitigation or compensation for habitat damages.

Of particular relevance to anadromous fish habitat restoration or enhancement is the WRDA of 1986. This Act authorized the COE to study and construct environmental enhancement projects in conjunction with existing federal water projects.

STATE MANAGEMENT INSTITUTIONS, LAWS, REGULATIONS AND POLICIES.

State management institutions, laws and regulations for the Gulf sturgeon are relatively consistent among the four Gulf States within the species' range. Each state delegates substantial authority to its administrative agencies for establishing management regulations. Brief narrative descriptions are presented below for each state institution. Important state laws, regulations and policies are also summarized. **To the greatest extent possible, these requirements are current to the date of publication.**

FLORIDA

Administrative Organization.

Florida Marine Fisheries Commission
2540 Executive Center Circle West, Suite 106
Tallahassee, FL 32301
Telephone: (904) 487-0554

The Florida Marine Fisheries Commission, a seven-member board appointed by the governor and confirmed by the senate, was created by the Florida legislature in 1983. This commission was delegated rule-making authority over marine life in the following areas of concern: gear specification; prohibited gear; bag limits; size limits; species that may not be sold; protected species; closed areas; seasons; quality control codes with the exception of specific exemptions for shellfish; and special considerations relating to oyster and clam relaying. All rules passed by the commission require approval by the governor and cabinet. The commission does not have authority over endangered species, license fees, penalty provisions or over regulation of fishing gear in residential saltwater canals.

Florida Department of Environmental Protection (FDEP)
Division of Marine Resources
3900 Commonwealth Boulevard
Tallahassee, Florida 32303
Telephone: (904) 488-6058

This agency is charged with the administration, supervision, development and conservation of marine natural resources in Florida. The Florida Department of Natural Resources was the predecessor marine resources agency until its merger with the Florida Department of Environmental Regulation July 1, 1993. The agency is headed by the Governor and Cabinet. The governor and cabinet serve as the seven-member board that approves or disapproves all rules and regulations promulgated by the FDEP. The administrative head of the FDEP is the Department Secretary. Within the FDEP the Division of Marine Resources, through Section 370.02(2), Florida Statutes, is empowered

to conduct research directed toward management of marine and anadromous fisheries in the interest of all people of Florida. The Division of Law Enforcement is responsible for enforcement of all marine resource related laws and all rules and regulations of the department. The Division of Marine Resources has the responsibility of overseeing the management and research efforts on the Gulf sturgeon including issuance of collecting permits for the subspecies.

Florida Game and Fresh Water Fish Commission.
Division of Wildlife
620 South Merdian Street
Tallahassee, Florida 32399
Contact: Mr. Don A. Wood, Endangered Species Coordinator
Telephone: (904) 488-3831

This agency is charged with the administration, supervision, development and conservation of wildlife and fresh water aquatic life in Florida. The FGFC is a constitutionally autonomous agency and is overseen by a governor appointed five-member board. The administrative head of the FGFC is the executive director. Within the FGFC the Division of Wildlife Resources, in accordance with the Florida Endangered and Threatened Species Act of 1977, Section 372.072, Florida Statutes, and the Wildlife Code of the State of Florida, Title 39, Florida Administrative Code, Article IV, Sec. 9, Florida Constitution, is responsible for research and management of listed fresh water and upland species. These efforts include the administrative designation of all wildlife species (including marine and estuarine species), issuance of collection permits, and various types of research of listed upland and fresh water aquatic wildlife species. The Gulf sturgeon was listed as a species of special concern by the FGFC in 1987.

Florida has habitat protection and permitting programs and a federally-approved Coastal Zone Management (CZM) program.

Legislative Authorization. Chapter 370 of the Florida Statutes Annotated contains law regulating coastal fisheries. The legislature passes statutes for the management of fisheries resources as well as specific laws which are applicable within individual counties.

Reciprocal Agreement and Limited Entry Provisions. Not applicable, since any take of Gulf sturgeon is illegal in Florida.

Commercial Landings Data Reporting Requirements. Not applicable since all take of Gulf sturgeon is illegal in Florida.

Penalties for Violations. Penalties for violations of Florida statutes and regulations are prescribed in Section 370.021, Florida Statutes. Upon the arrest and conviction for violation of any of the regulations or laws, the license holder shall show just cause why

his saltwater license should not be suspended or revoked.

Annual License Fees. Not applicable, since all take of Gulf sturgeon is illegal in Florida.

Laws and Regulations. It is illegal to take *Acipenser oxyrinchus* by any means statewide according to Rule No. 46-15.01 (1984) of the Florida Marine Fisheries Commission. (Most federal and state agencies have used the specific name *A. oxyrinchus* instead of the subspecific name *A. o. desotoi*.

ALABAMA

Administrative Organization.

Alabama Department of Conservation and Natural Resources (ADCNR)
Alabama Marine Resources Division (AMRD)
P.O. Box 189
Dauphin Island, Alabama 36528
Telephone: (205) 861-2882

Management authority of fishery resources in Alabama is held by the Commissioner of the Department of Conservation and Natural Resources. The Commissioner may promulgate rules or regulations designed for the protection, propagation and conservation of all seafood. He may prescribe the manner of taking, times when fishing may occur and designate areas where fish may or may not be caught; however, all regulations are to be directed toward the best interest of the seafood industry.

Most regulations are promulgated through the Administrative Procedures Act approved by the Alabama Legislature in 1983; however, bag limits and seasons are not subject to this Act. The Administrative Procedures Act outlines a series of events that must precede the enactment of any regulations other than those of an emergency nature. Among this series of events are (a) the advertisement of the intent of the regulation, (b) a public hearing for the regulation, (c) a 35-day waiting period following the pubic hearing to address comments from the hearing and (d) a final review of the regulation by a joint house and senate review committee.

Alabama also has the Alabama Conservation Advisory Board (ACAB) that is endowed with the responsibility to provide advice on policies of the ADCNR. The board consists of the governor, the ADCNR commissioner and ten board members.

The AMRD has responsibility for enforcing state laws and regulations, for conducting marine biological research and for serving as the administrative arm of the commissioner with respect to marine resources. The division recommends regulations to the commissioner.

Alabama has a habitat protection and permitting program and a federally approved CZM program.

Legislative Authorization. Chapters 2 and 12 of Title 9, Code of Alabama, contain statutes that concern marine fisheries.

Reciprocal Agreement and Limited Entry Provisions. Not applicable since all take of Gulf sturgeon is illegal in Alabama.

Commercial Landings Data Reporting Requirements. Not applicable since all take of Gulf sturgeon is illegal in Alabama.

Penalties for Violations. Take of Gulf sturgeon is illegal in Alabama, any take is considered a Class C misdemeanor and punishable by fines up to $500.00 and three months in jail.

Annual License Fees. Not applicable since all take of Gulf sturgeon is illegal in Alabama.

Laws and Regulations. It is currently illegal to take Gulf sturgeon in freshwater or coastal waters in Alabama. Alabama has no official State list of threatened and endangered species. *Acipenser oxyrinchus* is considered a threatened species by the Symposium on Endangered and Threatened Plants and Animals of Alabama (Boshung 1976).

MISSISSIPPI

Administrative Organization.

Mississippi Department of Wildlife, Fisheries and Parks (MDWFP)
Bureau of Marine Resources (BMR)
2620 Beach Boulevard
Biloxi, Mississippi 39531
Telephone: (601) 385-5860

The MDWFP administers coastal fisheries and habitat protection programs through the BMR. Authority to promulgate regulations and policies is vested in the Mississippi Commission on Wildlife, Fisheries and Parks, the controlling body of the MDWFP. The commission consists of five members appointed by the governor. The commission has full power to "manage, control, supervise and direct any matters pertaining to all saltwater aquatic life not otherwise delegated to another agency" (Mississippi Code Annotated 49-15-11).

Mississippi has a habitat protection and permitting program and a federally approved CZM program.

Legislative Authority. Chapter 49-15 of the Mississippi Code of 1972 (Annotated) contains provisions for the management of marine fisheries resources.

Reciprocal Agreement and Limited Entry Provisions. Not applicable since it is illegal to take Gulf sturgeon anywhere in the State of Mississippi.

Commercial Landings Data Reporting Requirements. Not applicable since it is illegal to take Gulf sturgeon anywhere in the State of Mississippi.

Penalties for Violations. Any person, firm or corporation violating any of the provisions of Chapter 49-15 or any ordinance duly adopted by the commission, unless otherwise specifically provided for herein, shall, on conviction, be fined not less than $100, nor more than $500, for the first offense, unless the first offense is committed during a closed season, in which case the fine shall be not less than $500, nor more than $1,000; and not less than $500, nor more than $1,000, for the second offense when such offense is committed within a period of 3 years from the first offense; and not less than $2,000 nor more than $4,000, or imprisonment in the county jail for a period not exceeding 30 days for any third or subsequent offense when such offense is committed within a period of 3 years from the first offense and also upon conviction of such third or subsequent offense, it shall be the duty of the court to revoke the license of the convicted party and of the boat or vessel used in such offense, and no further license shall be issued to such person or for said boat to engage in catching or taking of any seafoods from the waters of the State of Mississippi for a period of 1 year following such conviction. Further, upon conviction of such third or subsequent offense committed within a period of 3 years from the first offense, it shall also be the duty of the court to order the forfeiture of any equipment or nets used in such offense. Provided, however, that equipment as used in this section shall not mean boats or vessels. Any person convicted and sentenced under this section shall not be considered for suspension or other reduction of sentence. Except as provided under subsection 5 of Section 49-15-45, any fines collected under this section shall be paid to the Mississippi Commission on Wildlife, Fisheries and Parks to be paid into the Seafood Fund.

Annual License Fees. Not applicable since it is illegal to take Gulf sturgeon anywhere in the State of Mississippi.

Laws and Regulations. *Acipenser oxyrinchus* was listed as an endangered species by the Mississippi Game and Fish Commission and the Rare and Endangered Species Committee (1975) and is protected by law. The subspecies is also listed as endangered by the Mississippi Natural Heritage Program, 1977, and as a Special Animal Species by the Mississippi Parks Commission, Bureau of Outdoor Recreation, Jackson, MS.

LOUISIANA

Administrative Organization.

Louisiana Department of Wildlife and Fisheries (LDWF)
P.O. Box 98000
Baton Rouge, Louisiana 70898
Telephone: (504) 765-3617

The LDWF is one of 21 major administrative units of the Louisiana government. A seven-member board, the Louisiana Wildlife and Fisheries Commission (LWFC) is appointed by the Governor. Six of the members serve overlapping terms of six years, and one serves a term concurrent with the Governor. The commission is a policy-making and budgetary-control board with no administrative functions. The legislature has sole authority to establish management programs and policies; however, the legislature has delegated certain authority and responsibility to the LDWF. The Secretary of the LDWF is the executive head and chief administrative officer of the department and is responsible for the administration, control and operation of the functions, programs and affairs of the department. The secretary is appointed by the Governor with consent of the Senate.

Within the administrative system, an Assistant Secretary is in charge of the Office of Fisheries. In this office a Marine Fisheries Division and an Inland Fisheries Division may have management jurisdiction over the Gulf sturgeon. The Enforcement Division, in the Office of the Secretary, is responsible for enforcing all fishery statutes and regulations.

The LDWF's Natural Heritage Program is responsible for administering the laws, rules, and regulations regarding threatened and endangered species (R.S. 56:1830). In addition, under a full authorities Section 6 agreement with the FWS, the take of threatened and endangered species may be authorized by permits issued by the Department.

Louisiana has habitat protection and permitting programs and a federally approved CZM program.

Legislative Authorization. Title 56 Louisiana Revised Statutes contains rules and regulations that govern marine fisheries in the state.

Reciprocal Agreement and Limited Entry Provisions. Not applicable, since take of Gulf sturgeon is illegal in Louisiana.

Commercial Landings Data Reporting Requirements. Not applicable, since take of Gulf sturgeon is illegal in Louisiana.

Penalties for Violations. The fine for each illegally caught fish is $2,500.00

Annual License Fees. Not applicable, since take of Gulf sturgeon is illegal in Louisiana.

Laws and Regulations. Louisiana law currently prohibits take of all sturgeon anywhere in the state. The Louisiana Division of Natural Heritage is responsible for listing of endangered and threatened species.